Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XL. NEW YORK, SATURDAY, AUGUST 30, 1902. No. 9.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

114 LIBERTY STREET, NEW YORK.

PUBLISHED WEEKLY.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

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CHICAGO OFFICE, - - - - - - - - - - 1139 Monadnock Block.
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ELECTRICAL WORLD AND ENGINEER.

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United States, Canada or Mexico, - - - - - - - - - - - per year, $3.00
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Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, AUGUST 30, 1902.

CONTENTS.

Editorial 313
Westinghouse Single-Phase Railway System for Washington-Baltimore Road 316
American Street Railway Association 316
The Housing of a Telephone Plant. By Herbert Laws Webb 317
Insurance on Automobiles 324
The Magnetic Properties of Iron and Steel at Liquid Air Temperatures. By C. C. Trowbridge 325
Underground Work for Telephone Exchanges—I. By Arthur V. Abbott, C. E. 328
New York State Electrical Laboratory 329
Coin Collecting Telephone Stations 330
Fessenden Wireless Telegraph Apparatus 332
The Value of Telephone and Telegraph Investments 332
American Electrochemical Society 333
Transposition of High-Potential Alternating-Current Lines 334
Electrical Classification of Exhibits, St. Louis World's Fair 335
Electroplated Lace. By Clinton Paul Townsend 335
Current News and Notes 335
LETTER TO THE EDITORS:
The Second Law of Thermodynamics. By Irving A. Taylor 336
Digest of Current Electrical Literature 337
New Book 341
Small Electric Motors for "Industrial" Railways 342
A Gasoline-Electric Dray 342
New Type of Telephone Counter 343
Telephone Switchboard 343
Telephone Service for a New Hotel at Indianapolis 343
An Electrical "Snip" 343
Three-Way Valves 343
DEPARTMENTS:
Financial Intelligence 344
Commercial Intelligence 345
General News 347
Trade Notes 351
Record of Electrical Patents 352

TELEPHONE EXCHANGES AND CONDUITS.

The various branches of applied electricity—electric lighting, the transmission of power, electric railways, and the construction of dynamo machinery—have from their inception received the closest attention of the highest engineering ability, until to-day electrical engineering at least now begins to equal the other members of the great constructive quartet in the number and ability of the men engaged therein. But the art of the electrical transmission of intelligence, telephonically, absorbing a goodly share of the billions of capital invested in electrical enterprises, has received the least share of engineering attention. This is partly due to the nature of this department. To design a thousand-kilowatt dynamo, to build a railway to run 60 miles an hour, to illuminate a million lamps, to transmit a hundred thousand horse-power, are present questions that are both attractive and tangible in magnitude; but to construct a pole line carrying a handful of No. 10 wires, to bury a few cables in a city street, or to deal with the micro-amperes of the telephone transmitter, are problems that lack exciting attraction. Further, in the case of the telephone, in ante-independent days only a special few were admitted inside the technical arena.

To-day these conditions are already changed and are rapidly undergoing further modification. And as engineering is only scientific planning, millions invested in telephonic plants are certainly entitled to their share of consideration. The expense of the wire plant forms about one-half of the total investment in a telephone exchange; and in the extensive series of articles just completed in these pages Mr. Abbott has developed more clearly and extensively than had previously been attempted the method of design to render the quantity of wire plant for a given territory a minimum. In our current number, wire-plant construction is taken up by Mr. Abbott and treated in a similar fashion, with particular attention to methods of estimating cost of installation and the annual amounts required for depreciation and maintenance. Taken in conjunction with the preceding series, the telephone engineer will be advised as to the design of a given installation to reach all subscribers with the minimum of wire-plant expenditure, to calculate its installation cost, and to estimate the proper annual expense to be charged against this portion of the plant in making up tariff sheets.

The object of all this construction is, of course, to maintain continuity of service and enable subscribers to get swiftly into touch with each other. Another part of the work which has proceeded with equally liberal outlay has been that of exchange construction, aiming at identical purposes, and, indeed, depending for its ideal development upon the perfection of trunking methods and an abundance of well-insulated cables. We present in this issue also a most interesting article by Mr. H. L. Webb, in which that well-known engineer traces with accustomed clearness and charm of style the evolution of the modern telephone exchange building. The article is, we believe, the first of the kind; at least we do not recall anything of the same nature, and probably only New York could afford an example of so many modern types of exchange buildings connected into one city network. This line of development, like that of subway construction, is expensive, and involves a tremendous investment in real estate and plant. It is obviously that success depends not only on skilful engineering but the highest quality of business management; and we

imagine that there are points touched upon and discussed of interest to the telephonists wherever they are found, and no matter what the size of their plant.

THE FREEDOM OF THE AIR.

Anent wireless telegraphy, what a truly beautiful chance for litigation will arise when the various systems get down to doing commercial business. One cannot patent the winds of Heaven nor copyright the ether, and if the Etheric Vibration Company, Limited, and the Donnerwetter Communications Company get by accident or design into dynamical conflict, who shall decide between them? One cannot order the former on higher poles or compel the latter to use complete metallic circuits. This is no mere fancy picture of twentieth century complications, but a condition that is quite likely to arise within a very few years, perhaps even sooner. And when the wireless systems are regularly used in the army and navy it is doubly necessary that the ordinary exigencies of commercial work should not be allowed to interfere with national defense. An example in point is given by a recent experience off Tunis, where communication between French warships and the shore was interrupted by a French resident, who explained that his apparatus had been fitted up to interfere with messages between foreign ships. A serious condition of affairs is thus likely to arise at almost any time, and it is no subject for joking, however facetious the idea may seem.

We are no advocate of the general government ownership of public utilities, but it seems to us that in this case if ever it is not only justifiable but necessary. As well permit every steamship line to maintain an independent system of buoys and light houses as to allow half a dozen warring codes to interfere with national necessities. We believe it would be wise to have by international agreement, if necessary, all land stations absolutely owned and operated by the respective governments involved, and if necessary in one uniform way. Such a step might hamper the adoption of improved apparatus as it may in course of time be invented, but it would do what nothing else except a private monopoly could do—reduce the matter to general and harmonious usefulness. Uncle Sam has been very chary in using his right of eminent domain—often to his great loss, but other governments have discovered long ago the advantage of controlling some things of national importance, and have not hesitated to do so. Our government cannot in time of peace take property without reimbursement, and does not do so in time of war, but it has the right and should exercise the power to take when necessary what it requires at a fair price, and so the acquirement of what rights might be necessary is not really a complicated matter. Not only is wireless telegraphy likely to assume no small importance in the regulation of commerce, but it has international relations that remove it from the category of ordinary commercial enterprises and make it a proper subject for exclusive control by the government. Only in this way can its full usefulness be realized when it reaches complete commercial development. At least, so it seems now.

A SINGLE-PHASE ELECTRIC RAILWAY

As our readers are aware, we have in season and out of season during the past several years preached the doctrine of alternating-current traction, pointing out in particular that in view of the work being done along this line in Europe the apathy here toward this development seriously menaced American leadership in electric railway engineering. This attitude was far from meeting with approbation in all quarters, and it is, therefore, a natural source of gratification that recent events have vindicated our stand. At the recent meeting at Great Barrington of the American Institute of Electrical Engineers, the feature of the sessions was the announcement by Mr. B. J. Arnold of an entirely original system of single-phase alternating-current traction, soon to be installed on a Western road, and which contains every promise of commercial success. We have now the pleasure of announcing, as will be seen elsewhere in our columns, that the Westinghouse Company has contracted for the equipment of an important long interurban road with alternating current. More than this, it has developed and will here install a complete traction system for the use of single-phase currents, employing variable speed motors. Heretofore in this country, alternating polyphase currents have been used for traction purposes merely for the operation of rotary converters, gaining thereby the power to use standard railway equipments, but forfeiting the chief advantages of alternating-current distribution. So long as the substation with rotaries is retained, there is a very material loss of energy, need for considerable attention and a severe limitation upon the voltage of the working conductor. In using polyphase equipments for the cars along the lines developed abroad, the full advantage of the alternating system is realized, but the trolley system becomes seriously complicated by the need for two or three working conductors. One may realize how considerable an obstacle this may be by noting the recent proposal of so eminent an engineer as Mr. Huber, to use single-phase alternating currents for the distribution at high voltage and to reduce this to usable form by a rotary converter on the car.

In the equipment now under way, a radical step has been taken in the adoption of single-phase variable speed motors on the cars, thus gaining the advantage of alternating distribution without a sacrifice in the simplicity of the system of working conductors. The details of this new motor system are promised soon to be forthcoming, but it is safe to say in advance that it must embody some novel and valuable features, else so powerful and conservative a corporation would not venture to stand behind it in so important an installation. We shall not venture to comment upon the means employed before the whole matter is made public, but it is safe to say that they have been worked out in a manner at once thorough and resourceful. Up to the present time the single-phase alternating motor has been essentially a one-speed machine capable of doing excellent work at its designed load, but weak in starting and performing badly, save near its regular speed. Both strong starting torque and variable speed have been in one way and another secured, but hitherto at very serious sacrifices, so that the system has hardly been commercial. But inventive genius and constructive skill combined sometimes accomplish the unexpected, and we do not believe that the new system of Mr. B. G. Lamme will be found wanting in these particulars. It should be remembered that the ordinary series-parallel control was tried and cast into the scrap heap some years before it was, largely by the efforts of a single indefatigable engineer, converted into a brilliant success. Such may be the history of the alternating current railway motor, and while it is unwise to crow before one is out of the woods, we hope to hail with unqualified commendation the success of so notable an enterprise as the one now announced. The proof of the pudding will be in the eating, and practical results in the severe work of interurban traction is a test from which there is no appeal. We shall follow this installation with the greatest interest and care, and meanwhile tender our hearty congratulations on the inauguration of what we hope will be another epoch-making enterprise.

THE SECOND LAW OF THERMODYNAMICS.

In our correspondence columns this week, Mr. Irving A. Taylor discusses the questions raised by us in a recent editorial on the second law of thermodynamics. Mr. Taylor agrees with our position from

a practical point of view, but demurs when the subject is discussed theoretically. Our position has been that in any space containing a warm fluid, such as air, at one and the same temperature throughout, there will be heat energy in the fluid, but none of it will be available for conversion thermodynamically into mechanical work, because all heat-engines require and operate by virtue of difference of temperature.

It is true, as pointed out by our correspondent, that according to the existing kinetic theory of gases and to Maxwell's theory of imaginary daemons, it would be possible to utilize the heat of a uniformly warmed air-chamber and convert it into mechanical work. Maxwell drew, in imagination, a bulkhead or partition across the chamber, thus converting it into two sub-chambers, punched myriads of extremely minute holes in the partition, set a little trap-door over molecules of air at any uniform temperature, say traveling to-and-fro at a certain mean velocity, colliding, rebounding, and zig-zagging in every direction. The actual velocity of any one molecule will often be much more than the mean, and also often much less. If the daemon at each hole opened the door whenever a molecule happened to head for it at any velocity above the mean, but kept it shut when the velocity was less than the mean, the temperature on the sides of the partition would commence to differentiate, one sub-chamber becoming full of hotter air, and the other of colder air, although the mean temperature of all would remain unchanged. After a sufficient lapse of time there would be enough difference of temperature between the two sub-chambers to work a heat engine, and bring both to one and the same lower temperature, after liberating mechanical work.

This is all theoretically true. It merely means that a difference of temperature is conceivably obtainable from uniform temperature by the action of intelligence upon a sufficiently small scale. It does not really imply any fallacy in the second thermodynamic law. Intelligence acting on the scale of our own mundane affairs produces results that to sufficiently magnified giants might seem equally wonderful. To a being of sufficient size to make a coal mine seem as but a capillary tube, the human realization of energy by burning air and coal together, might seem fantastically wondrous. Intelligence acting on any scale may, by utilizing natural law, seemingly infract other natural law. In the absence of intelligence it is difficult to see how any difference of temperature could be made to arise within a heat-light and energy-light chamber, containing only a fluid at one temperature. Consequently, the second law of thermodynamics seems to apply to every case we can conceive of. Of course, we can postulate conditions under which the second law of thermodynamics would fail. But this is virtually postulating a new world. The burden of proof lies on the asseverator of the fallacy of this rule, which is in accordance with all human recorded experience up to the present time. In all these views we think we retain our correspondent's acquiescence.

THE MAGNETIC PROPERTIES OF IRON AND STEEL AT LOW TEMPERATURES.

The article of Mr. C. C. Trowbridge on this subject, appearing on page 325, deserves careful attention. In the first place, it clears up a common misconception as to the temperature of liquid air. This is usually accepted as — 185° C., as though it had a definite value like the boiling point of water under normal atmospheric pressure. Owing, however, to air being a mixture of the two gases, oxygen and nitrogen, each having a different boiling point, the temperature of liquid air may be anywhere between these two boiling points, according to the relative proportions of the two gases present, and to their previous history. That is to say, the temperature will be not above — 181.4°, nor below — 194.4°, and usually in the neighborhood of — 185°.

Liquid air with this low temperature, less than 90° above the inferred absolute zero, gives to the experimentalist a rich field of investigation concerning the influence of low temperatures upon any particular phenomenon. The descent from normal temperature to that of liquid air is nearly as great as the ascent from normal temperature to that of boiling oils.

The results of the magnetic researches at the temperature of liquid air, mentioned in the article, lead to the remarkable conclusion that, in the samples tested, the magnetization of steel was practically the same, whether effected at the temperature of air liquified, or at the temperature of the air we breathe. We know that at red heat it is impossible to communicate any appreciable magnetization to a bar of steel. The magnetization increases as the temperature falls; but in the case of the samples here tested, the magnetization is not very different whether communicated at 20° C. or at — 185° C.

It is much to be desired that all such magnetic tests might be made on steel rings magnetized by coils of wire, so as to obtain a closed magnetic circuit, and a complete Ewing cycle, at these temperatures contrasted. With simple steel bars, although the information gained by measuring the magnetic moment is certainly better than none, it is inferior, from a quantitative point of view, to the complete hysteretic cycle or loop.

A very interesting deduction is raised by the determination of the permeability of liquid air. It seems that although liquid air is regarded as a magnetic substance, yet its permeability is only about one-third of 1 per cent. in excess of the permeability of ordinary gaseous air. In spite of this relatively feeble permeability, as compared with iron, it seems that, volume for volume, the susceptibility of liquid oxygen is about 1,600 times greater than that of gaseous oxygen. According to this deduction, magnetic susceptibility increases markedly in oxygen with the density, or mode of aggregation.

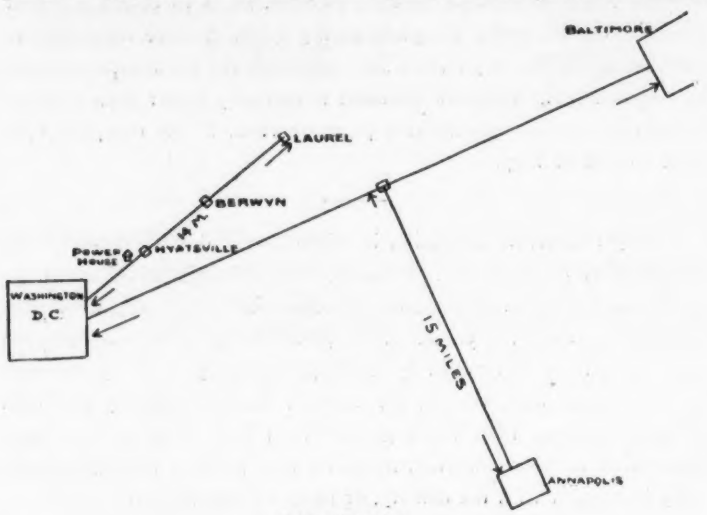
The following interesting fact is also elicited from the results: When an iron or steel bar is powerfully magnetized at ordinary temperatures, it will lose magnetism if heated, and it will also lose magnetism if cooled. The loss accompanying initial heating is greater than the loss accompanying initial cooling; but what goes off within a small range of temperature in either case may be regarded as subpermanent magnetism readily dislodged. After a few cycles have been passed through, however, and the magnet enters a fairly steady condition, then heating will always weaken the magnet, while cooling in liquid air will usually strengthen it. This is what one would expect from a Ewing model, containing a number of poised compass needles freely suspended in each other's vicinity. The separation of the needles, as by thermal expansion of their framework, should diminish the total magnetic moment of the mass, while the act of crowding the needles nearer together, as in cooling, should increase the total magnetic moment.

It is stated that the hysteresis loss in iron at high induction densities is the same at normal and at very low temperatures. If this is a correct generalization it is very remarkable, since it would tend to show that not only the area, but also the shape of the hysteresis loop is the same at these various temperatures.

Westinghouse Single-Phase Railway System for Washington-Baltimore Road.

A contract has recently been closed for an electric railway on entirely new lines, to connect Washington, Baltimore and Annapolis. The importance of the work as measured by the magnitude of the road itself and the novelty and possibilities of the system which is employed, promise to make this one of the most notable steps in electric railway work which has been undertaken in this country.

The Washington, Baltimore and Annapolis Electric Railway Company has awarded a contract for the entire electrical equipment of its lines to the Westinghouse Electric and Manufacturing Company. The road throughout is to be operated by alternating current. There are no rotary converter substations, and the motors upon the cars are single-phase, alternating current motors. While alternating-current railways have been exploited to some extent in Europe, no railway system employing alternating-current motors has thus far been undertaken in America. What, however, makes the present undertaking one of notable interest is that it will not follow the lines employed in Europe, where the alternating-current railway system thus far installed employs polyphase currents and at least two overhead contacts. It has been asserted that the induction motors which are used in the European service have a number of characteristics which do not adapt them to ideal railway service. Among the difficulties which have been pointed out in discussions which have appeared from time to time in the technical journals are the inflexibility of the motor, in that it is not operated efficiently at any speed except at approximate synchronous speed, and the power for starting the car is excessive. Moreover, the use of a double or triple-trolley system is maintained to be obviously highly objectionable, especially where high voltages are employed and cross-overs are necessary. Specific details of the new system as proposed by the Westinghouse Electric and Manufacturing Company, and have been adopted upon this road, are lacking, but it is stated that it avoids the inherent limitations of the induction motor and the disadvantages of a polyphase system of conductors by the use of single-phase current in the trolley and the motors.



MAP OF ROUTE.

The length of the line from Washington to Baltimore is a little short of 40 miles, and the Annapolis branch has an additional length of about 15 miles. For covering these distances from a single power house, the transmission voltage will be 15,000 volts directly from generators wound for this pressure. There are three engine-type generators of 1,500-kw each, at approximately 80 r. p. m. The pressure is lowered by ordinary lowering transformers placed at suitable intervals for supplying the current to the trolleys. There are nine substations with lowering transformers, and these supply 1,000 volts to an overhead trolley, one contact. The cars are of the large interurban type, and are provided with four motors, capable of developing a power equivalent to that of four ordinary railway motors of 100-hp capacity each. The motor is a variable speed motor which is said to have characteristics that adapt it for railway service fully as well as the ordinary direct-current railway motor.

The contract covers the complete equipment of electrical apparatus for power house, substations and cars. The controlling apparatus is of a new type, and is said to possess valuable features which have not been heretofore attained in railway operation, while avoiding many of the inherent difficulties in the ordinary systems of direct-current control.

The advantages in this system through the omission of rotary converters and attendance for them; also the reduction of copper over that which would be necessitated for operating direct-current motors at 500 volts, are among its notable commercial features. The adoption of 1,000 volts as the motor voltage was deemed by the engineers of the railway company to be preferable to a higher voltage, on the ground of general policy, although there is nothing in the system to prevent the use of several times this voltage. A higher voltage would probable be used on longer roads or where the conditions made a higher voltage more advantageous than in the present case. The car equipments are designed for a normal speed of 40 and 45 miles, and a maximum speed of 60 miles an hour.

This system has been developed by the Westinghouse Electric and Manufacturing Company, largely through the work of Mr. B. G. Lamme during the past few years. The final results were so satisfactory that the company was ready to undertake as an initial commercial installation a road of the size and importance of the one above described. The engineers of the railway company made a careful investigation of the system and of the motors which have been made and operated on the company's experimental railway track at Pittsburg, and as the outcome of their investigation they were satisfied to place the whole matter with the Westinghouse Company.

Work on this important enterprise is being pushed most vigorously. Excavation for the foundation of the power house to be constructed by the Washington, Baltimore and Annapolis Electric Railway, in East Hyattsville, will be begun the first week in September. The company has purchased an additional half-acre, making the total area for the power-house site three acres. This means that the original contemplated capacity of the plant will be increased, the additional power being required for the Chesapeake Beach Railway, which will discontinue the use of steam. It will take about 12 months to complete the power-house, the dimensions of which have been increased to 133 by 203 feet. The Hamilton-Corliss Engine Company will furnish the engines, and the boilers will be furnished by the Sterling Boiler Company. The engineers for the road are the Cleveland Construction Company, Mr. W. Christy, president.

The building alone will cost in the neighborhood of $350,000. The site was selected for the reason that it was convenient to water and railway facilities, and on account of its being located about midway between the Baltimore, Washington and Annapolis Electric Railway, and the City and Suburban Railway. It is also believed to be the intention of the officials of the first-named company to furnish power for manufacturing plants, said to be contemplated in this section. It is also probable that power will be furnished for lighting Hyattsville with electricity. A very interesting feature is that the company takes over a small existing direct-current road which will be fed by a substation with two 200-kw single-phase rotaries, these again being new machines of original design.

American Street Railway Association.

A preliminary programme of the twenty-first annual meeting of the American Street Railway Association announces that the meeting will be held in the Light Guard Armory, Detroit, Mich., Wednesday, Thursday and Friday, Oct. 8, 9 and 10, 1902. Papers will be presented on the following subjects:

"The Registration of Transfers," by Mr. C. D. Meenely, Brooklyn Heights Railroad Company.

"Benefit Associations," by Mr. Oren W. Root, Jr., Metropolitan Street Railway Company, New York.

"Discipline of Employes by the Merit System," by Mr. W. A. Satterlee, Metropolitan Street Railway Company, Kansas City.

"The Transportation of Light Express and Parcel Delivery," by Mr. George W. Parker, Detroit United Railway.

"Steam Turbine Engines," by Mr. E. H. Sniffen, New York.

"Signals for Urban and Interurban Railways," by an officer of the Old Colony Street Railway Company, Boston.

"The Adjustment of Damage Claims," Mr. M. B. Starring, Chicago City Railway Company.

There will be a large exhibition of street railway suppplies, as all the space in the hall is applied for. Thursday, Oct. 9, has been set apart as Exhibitors' Day.

The Housing of a Telephone Plant.

BY HERBERT LAWS WEBB.

LIKE other parts of a telephone system, the telephone building has undergone a striking evolution during the past few years. In New York, the city which has witnessed at once the greatest architectural and the most rapid telephonic development of any city in the world, a typical telephone building has been evolved, of which there are now six in use and five others planned or in course of construction. A large telephone exchange, needing a clear space for the operating room, has always required some amount of special construction or arrangement of the building to contain it, but the advisability of a specially designed telephone building first urged itself when underground conduits and cables came into extensive use; as not only was a permanent anchorage for the conduit and cable system most desirable, but it became necessary to provide special accommodation for the cables and their connections with the switchboards. At the beginning of the underground work, the cable and terminal accommodation was comparatively primitive, and but a slight advance on the style of construction used with overhead wires, while the power plant was practically non-existent, consisting usually of a single ringing machine, run by a water-motor. So that ten years ago a telephone exchange equipment required space only for the operating room and for a small terminal room, which contained all the auxiliary apparatus, and something in the way of operators' quarters. The operating room itself then occupied about nine-tenths, or at least four-fifths of the total space given over to the exchange. As telephone engineering has developed, this has changed very much, and the evolution of the modern telephone exchange into a highly complex organization of machinery may be followed in a most interesting way by studying the changes in the telephone building itself and the vastly increased space required in it to accommodate the exchange equipment. So great have been these changes that the telephone plant of to-day calls for a type and arrangement of building quite different from what was considered entirely adequate a few years ago.

The first radical change came about nearly nine years ago, when the bridging board with self-restoring drops came into use. With the bridging board came the power plant, storage batteries, motor generators for charging, ringing, testing and so forth; while these machines were few in number and of small size, they paved the way for the accommodation and treatment of the more imposing power plant required for the common battery system, now the accepted standard style of equipment for city telephone exchanges. Whereas

FIG. 1.—PLAZA CENTRAL OFFICE BUILDING, NEW YORK, SHOWING INTERIOR ARRANGEMENT.

in the telephone building of ten or twelve years ago, but a small amount of space was required for terminal equipment and power plant, in the common battery exchange of to-day the terminal equipment and power plant occupy nearly as much space as the operating room itself, in some exchanges quite as much. This is not suprising when it is considered that the terminal room of a common battery exchange contains, besides the main and intermediate distributing boards, apparatus that substitutes all the drops formerly in the switchboard and all the batteries and hand generators formerly at the subscribers' stations, together with a battery of generators of various types for furnishing the different kinds of current required to operate the exchange. With this extensive collection of machinery and its intricate and costly system of wiring to be accommodated, the operating room is no longer the main point to be considered in planning a telephone building, but equal consider-

ation must be given to the terminal room. The terminal room, in fact, has become the brains of the organism of which the switchboard is the face and the distributing cables are the nerves.

Perhaps the best way to illustrate the change that has taken place in the telephone building is to compare one of ten years ago with one of to-day. The Cortlandt Street building, completed in 1888, was designed mainly with a view to providing a top-story operating room for a 6,000-line switchboard, some 250 feet long, and an anchorage for the underground cable system of the downtown section of the city, in a structure as fire-proof as it could be made according to the methods of that day. The building was of eight stories, with a front of 72 feet, and two wings running back and enclosing a court reaching from the skylight of the second floor to the sky. This U-shaped form of building is the best arrangement for light and ventilation, and is adopted wherever possible. The eighth floor of the Cortlandt Street building was given over to the operating room, the ground floor to stores and a public pay station, and the intervening six floors to offices. As originally planned, the distributing rack was at the back of the switchboard, and the cables were led in from the street vault to a cellar on the same level, where they were headed up, and the wires were extended to the rack in the operating room by means of rubber-covered cables carried in ducts built in the wall of the building. This plan of handling the connections between the cable system and the switchboard was found to be unsatisfactory, and later a Hibbard distributing board was built in the cellar, to the opposite sides of which were connected the underground cable conductors and the house cables; these latter were then connected directly to the switchboard in regular order so that they became downstairs the terminals of the switchboard wires from having previously been upstairs the terminals of the cable conductors.

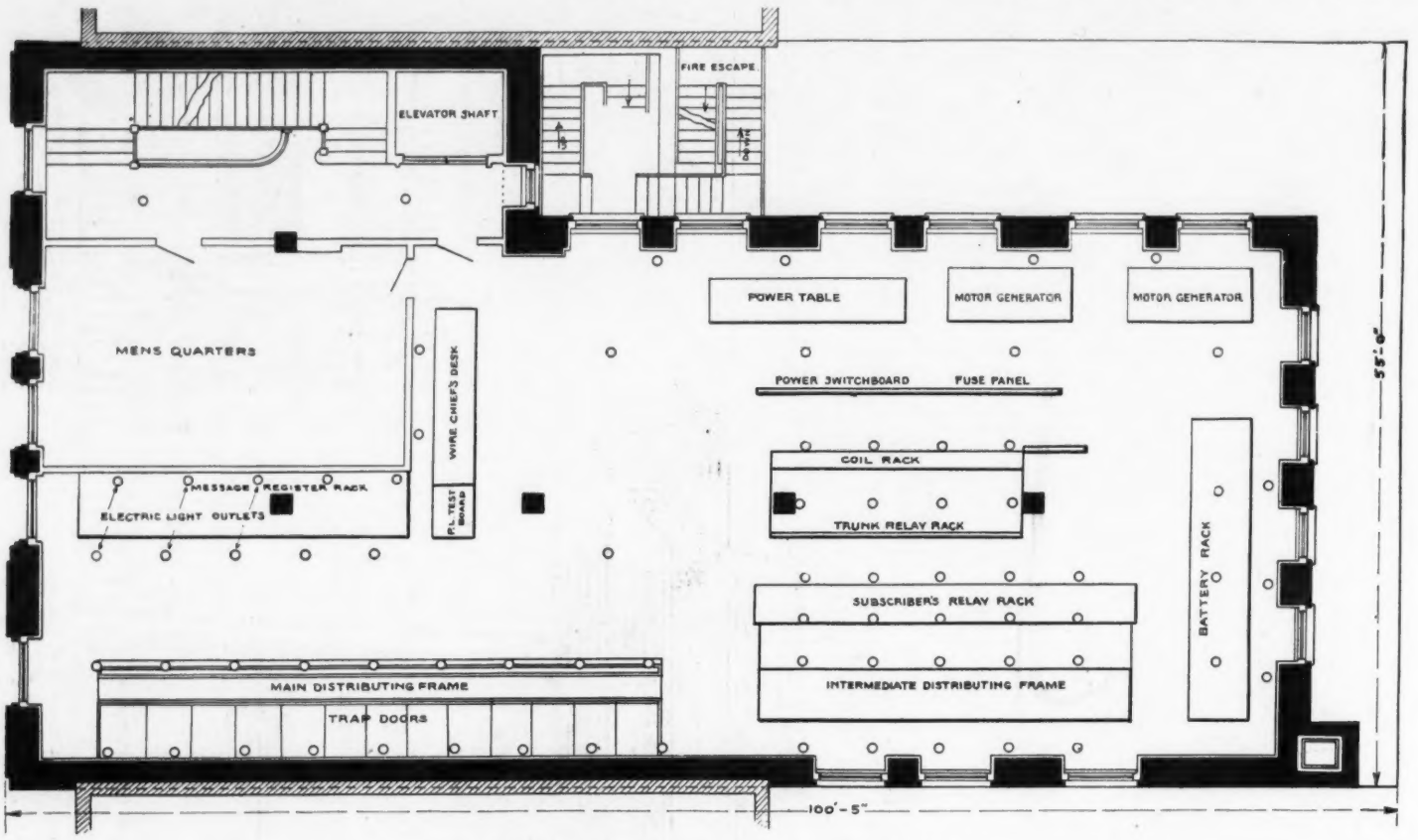


FIG. 2.—SECOND FLOOR PLAN, PLAZA CENTRAL OFFICE.

Practically all the room occupied by the telephone plant in the Cortlandt Street building, then, was the entire eighth floor and part of the cellar. A part of the seventh floor was used for operators' quarters, and the long-distance operating room occupied a small department at the end of the other wing of the seventh floor. The operating room and terminal room of the Long-Distance Company now occupy the entire seventh floor of the building, and the operators' quarters of the Long-Distance and of the New York Company occupy two whole floors of the Dey Street building. The Dey Street building was put up in 1896, as the accommodation in Cortlandt Street had become inadequate to the demands on it. At first the Cortlandt Street building provided space not only for the telephone plant, but also for the offices of all the departments of both telephone companies, and numerous offices were rented to outside tenants, chiefly electrical concerns. With the growth of the telephone business the telephone companies' offices expanded and the tenants were crowded out, and a few years later the Dey Street building was planned to provide additional office accommodation. This building adjoins the Cortlandt Street building at the back, and the two floors on the same level as the old and new operating rooms of Cortlandt Street are designed for operators' quarters. The other ten floors are occupied by the offices of the American Telephone and Telegraph and New York Telephone Companies, as are all the floors of Cortlandt Street not taken up by telephone plant. The working force of the New York Telephone Company has expanded so prodigiously since the days when *the* telephone building accommodated it all, that branches of it now occupy wholly or partially several other buildings in different parts of the city. The construction, maintenance, supply and repair departments occupy all of the John Street building not taken up by the John Street exchange equipment. The traffic department occupies a floor of the new Eighteenth Street building and part of a floor at Franklin Street, and the contract department has branch offices in the Thirty-eighth Street building, at Harlem, and in the new Melrose Building for the Bronx. It is at times almost as much of a problem to house the working force of the New York Telephone Company as it is to house its rapidly growing plant.

The recent additions to the Cortlandt Street building to accommodate the new common battery equipment were described in an article in ELECTRICAL WORLD AND ENGINEER at the time the new exchange was put in service. They comprised the supplement of a new wing to the building on its eastern side, to accommodate the terminal equipment, and the construction of a new top story over the old operating room. In a short time the construction will be begun of a new wing to the west on the lot at 22 Cortlandt Street to meet the ever-increasing demand for space for telephone exchange equipment. At the same time, the expansion of the offices will be met by the addition of three stories to the Dey Street building, making that building the full height of fifteen floors, for which it was originally planned. The additional wing to the Cortlandt Street building will also be of fifteen stories.

A few interesting reminiscences cling to the Cortlandt Street building, as is but natural with the first real telephone building. At the time I first knew it, the office of the electrician was one small back

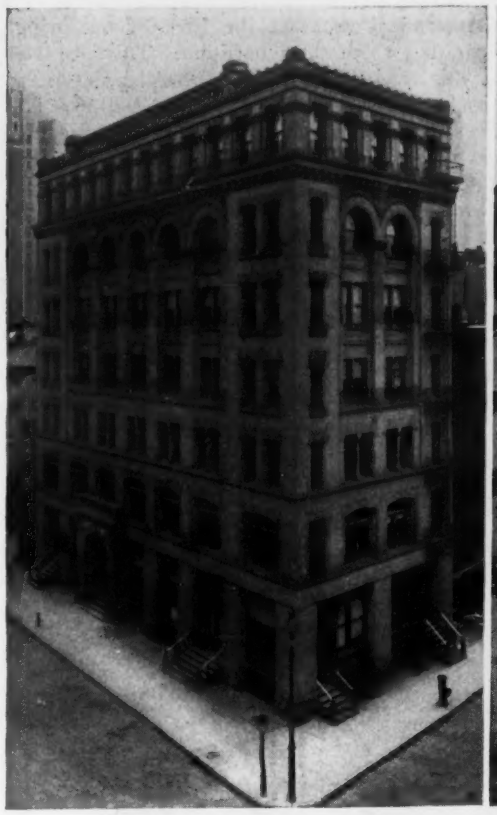


FIG. 3.—BROAD STREET CENTRAL OFFICE.

FIG. 4.—CORTLANDT STREET CENTRAL OFFICE.

FIG. 5.—DEY STREET BUILDING.

TYPES OF TELEPHONE EXCHANGE BUILDINGS.

FIG. 6.—JOHN STREET CENTRAL OFFICE.

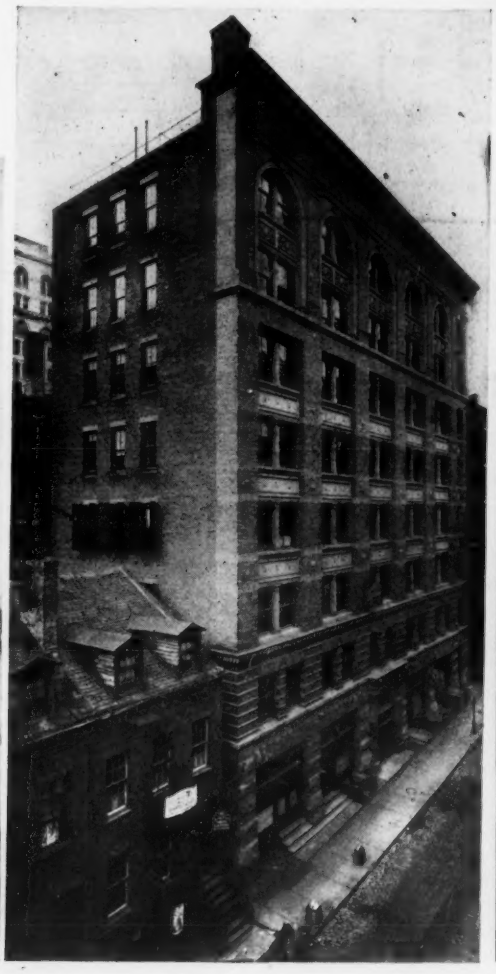


FIG. 7.—FRANKLIN STREET CENTRAL OFFICE.

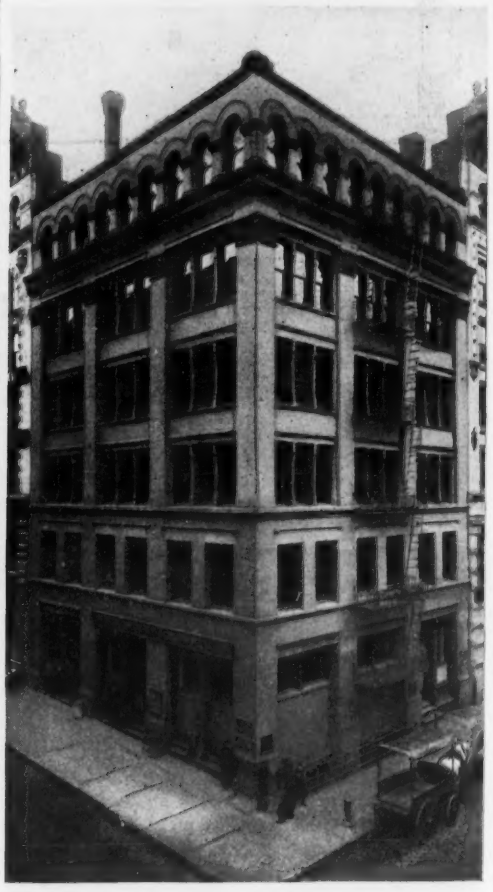


FIG. 8.—SPRING STREET CENTRAL OFFICE.

SOME OF THE CENTRAL OFFICES OF THE NEW YORK TELEPHONE COMPANY.

room, and the staff of that important department consisted of a foreigner of somewhat erratic disposition, and myself. The principal work of the electrician's department was the testing of underground cables, then being put in at the rate of several miles a week, and this had to be done with a very decrepit portable set of instruments supported on a barrel in the cellar, where the conditions were excellent for obtaining a good "spot," but unfavorable otherwise. The standards in the testing-set were none too reliable, and some of the results that my German confrère worked out from his tests would have startled any cable-maker. Shortly after this the present chief engineer of the company took the office of electrician, and from that time staff, instruments and accommodations improved quickly. At the present time the engineering department occupies the best part of a floor of the enlarged Cortlandt Street building, and its filing cases for drawings alone would not go into the room we had when Cortlandt Street was young. In 1890, in the budding electrical department, were carried on the experiments that resulted in the production of a piece of telephone equipment which shall be nameless here. That invention created a minor revolution in the art, and has contributed much to recent telephone history. In 1892, in the luxurious public station fitted up by the Long-Distance Company on the second floor of Cortlandt Street, occurred the historic inauguration of the New York-Chicago line by Professor Bell.

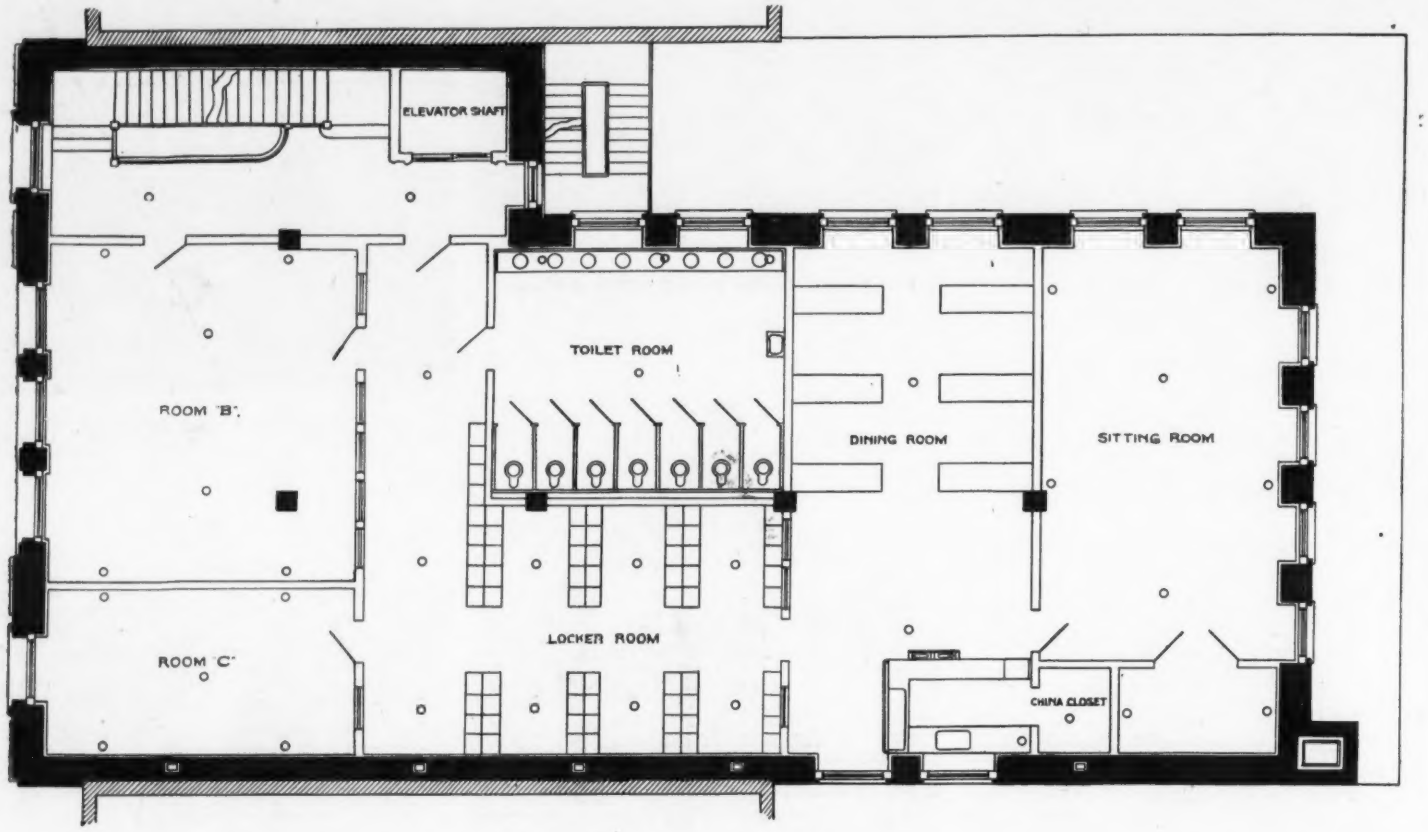


FIG. 9.—THIRD FLOOR PLAN, PLAZA CENTRAL OFFICE.

Leaving reminiscences and coming back to telephone buildings proper, the second telephone building to be erected in New York was Thirty-eighth Street. Here the experience gained at Cortlandt Street in handling the underground cables was taken advantage of in devising special arrangements for the treatment of the cables, terminals and connections to the switchboard. As the Thirty-eighth Street building and equipment served as a model for the other exchange buildings put up or converted during the next few years, in fact until the first typical common battery exchange of three years ago, a comparison of Thirty-eighth Street and one of the latest exchange buildings designed will show the great changes in the treatment of the building that the development of the telephone exchange equipment has brought about. The Thirty-eighth Street building is a copy of Cortlandt Street on a somewhat smaller scale, U-shaped, of fire-proof construction, and built of red brick and terra-cotta, after the same general Cortlandt Street style. As at Cortlandt Street, the operating room occupied the top floor, but it was determined, instead of terminating the underground cables in the cellar as at Cortlandt Street, to take them directly to the operating room floor and establish the terminal room at the back of one wing, separated from the operating room by a partition. This involved taking the cables from the street vault through the cellar the entire depth of the building and running them up a shaft to the top. The advantages of this plan were that it put the terminal equipment in light and airy quarters where everything was easily accessible for testing, and brought the distributing board close to the switchboard, thus simplifying the wiring between the terminals and the switchboard. The disadvantages were the length of underground cable required to reach from the exchange manhole to the rear of the top story, and the amount of construction required in the cellar and shaft to support the cables. These are pretty serious disadvantages. The cost of the cables entering a good sized exchange may amount to over a hundred dollars a foot, while the expense of a special shaft running the entire height of a building, the fire-danger of such a shaft, and the difficulty of placing new cables in it, furnish good reasons for abandoning the top-story terminal room wherever possible. The change in the type of exchange equipment has favored this, and the terminal room now needing an entire floor for its accommodation, the main distributing-board in the most modern exchanges is placed as near to the exchange manhole as possible. This applies, of course, to buildings situated in localities where space for renting to outside tenants would meet with no demand; to buildings, in short, designed exclusively for telephone purposes. In a district where office floors would be in demand, a high building would naturally be put up, and the whole exchange equipment would be on the upper floors. The cables would then have to go up the building to the terminal room, whose proper place is as near the operating room as possible. New York has several examples of each type of building.

The type of building and style of equipment adopted at Thirty-eighth Street were followed along the same general lines at Spring Street and Broad Street. Each of these exchanges is in a specially-designed telephone building, arranged, like the Cortlandt and Thirty-eighth Street buildings, so that the space not occupied by the exchange equipment could be rented for business purposes. At Spring Street the operating room occupied the whole of the top floor, the terminal room being placed one floor below; at Broad Street the terminal room was on the same floor as the exchange, in a separate apartment. The intermediate distributing board, by which the distribution of the line terminals in the switchboard may be changed, became standard practice in the early nineties, and was at first at-

FIG. 10.—EIGHTEENTH STREET CENTRAL OFFICE.

TYPES OF TELEPHONE EXCHANGE BUILDINGS.

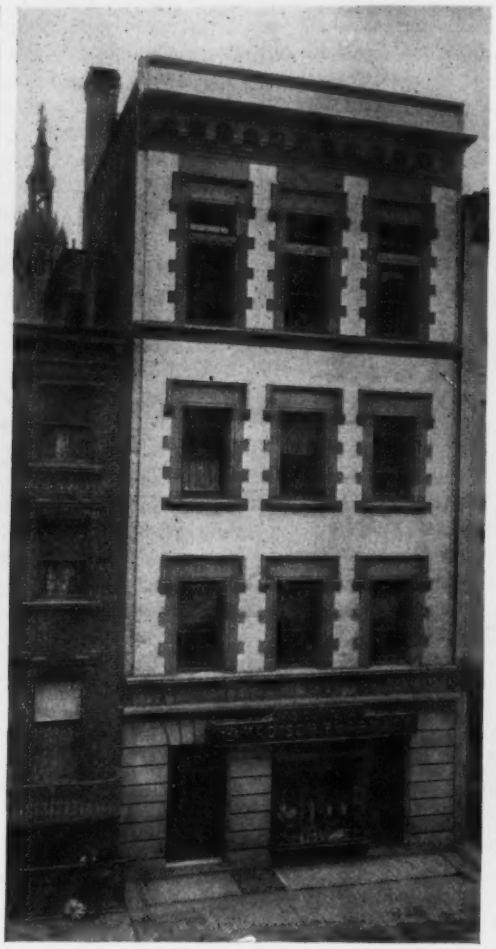


FIG. 11.—MADISON SQUARE CENTRAL OFFICE.

FIG. 12.—THIRTY-EIGHTH STREET CENTRAL OFFICE.

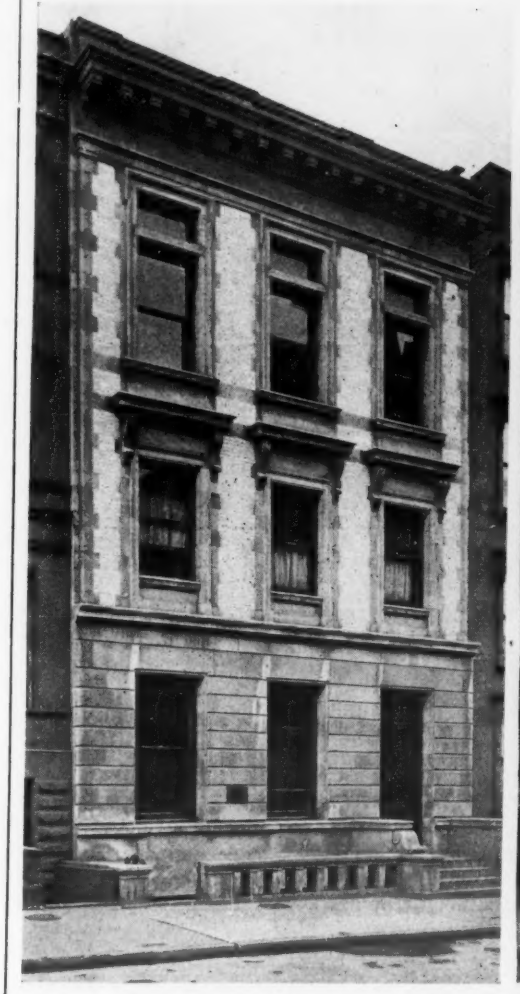


FIG. 13.—COLUMBUS CENTRAL OFFICE.

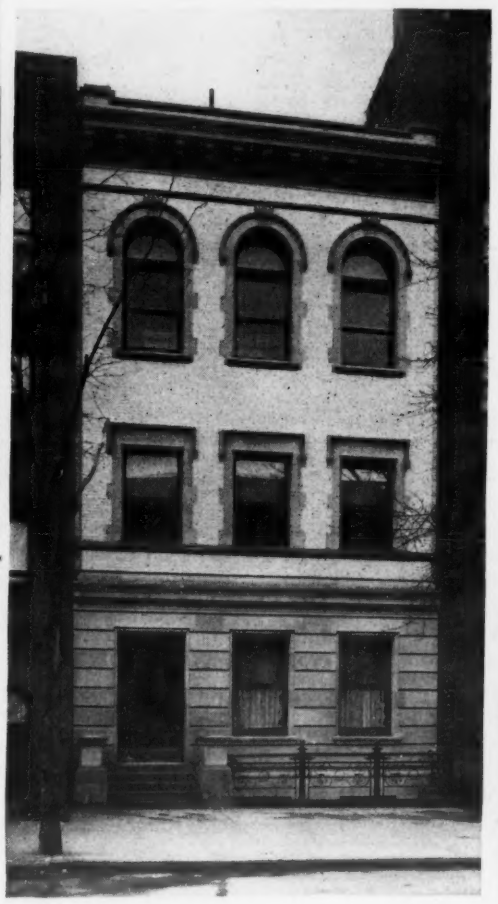


FIG. 14.—SEVENTY-NINTH STREET CENTRAL OFFICE.

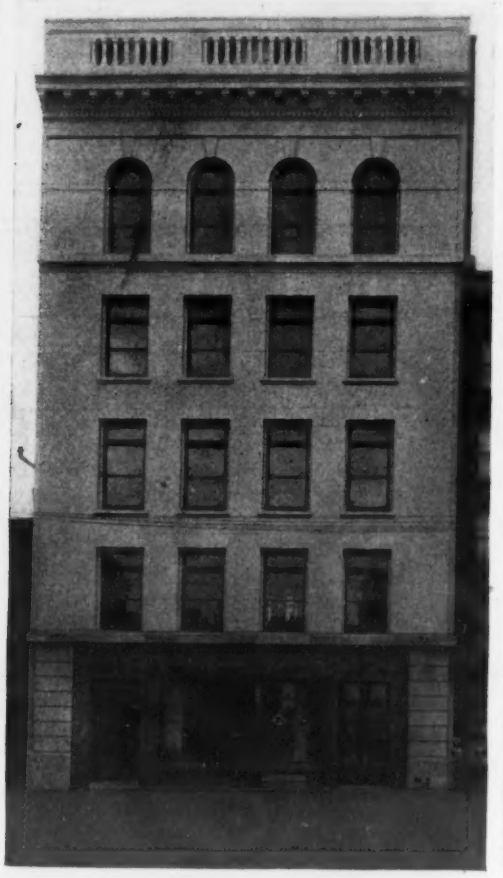


FIG. 15.—MELROSE CENTRAL OFFICE.

SOME OF THE CENTRAL OFFICES OF THE NEW YORK TELEPHONE COMPANY.

tached to the switchboard proper. It has since been moved into the terminal room, so that the operating room now contains nothing but the switchboard—and often is hard put to it to contain that, so rapidly do Manhattan exchanges grow. The cable shaft underwent some improvements in the buildings erected during the few years immediately after the equipment of Thirty-eighth Street. The shaft, from an ordinary square well, took the form of a broad shallow shaft, in which the cables were supported in a single row by means of transverse girders carrying cable clamps. Access to the shaft was had by means of doors at each floor. A little later both shaft and cableheads were done away with, the underground cables being brought up the building, each in a separate iron duct, and connected to the rubber cables leading to the distributing board by means of pot-head joints. These pot-heads were easily disposed of at the top of the ducts or under a false flooring, and the cumbersome cable-heads and spacious racks needed to support them disappeared from the exchanges for good. This improvement was introduced at the John Street exchange in 1896. This method of handling the cables when they have to be carried to any height, is safer both from the building point of view and from the cable point of view. The objections to a shaft and the danger to the cables in a shaft in case of fire are well understood. In the newer exchanges, as will be seen later, the cables do not run to the top of the building, but the most rigorous precautions to render the cable run fire-proof are observed. The house ducts are built into the wall and bricked over so that in no way do they form a shaft. Ducts not occupied by cables are plugged up at both ends. The latest practice in dealing with the cable heads is to do away with false floorings and to set the cable heads in the main floor itself, immediately adjacent to the main distributing frame, providing sheathed trap doors in the floor to give access to the cables. This is a gain in space and improves the general arrangement by giving a flush floor.

The John Street building was the first of the New York telephone buildings to be used from the beginning entirely for telephone purposes. Besides the exchange, it contains the supply department, the repair shop, and the offices and headquarters of the construction and maintenance departments. The first telephone building in New York occupied exclusively by a telephone exchange equipment was the Riverside exchange building, in West Eighty-ninth Street, which began service in 1899. The Riverside building is the type of the modern telephone exchange building, and has been the model for those erected since and for those now in course of construction. The Seventy-ninth Street and the Madison Square exchange buildings are almost exact replicas of Riverside, and the Columbus building is an enlarged Riverside. The Eighteenth Street building is still larger and has several floors arranged for offices, but the general style of the building and the arrangement of the equipment are similar to those adopted at Riverside, while the new exchanges, Orchard, Chelsea, Plaza, Harlem and Morningside, in Manhattan, and Melrose in the Bronx, will all be improved and enlarged Riversides.

In planning all of the telephone buildings, it has been a special point with the architects to make the general design of the building harmonize with the style of the surrounding houses. Most of the new exchanges are in residence districts, and, judging by a casual glance at the exterior, the telephone buildings, crammed from basement to roof with the very essence of business, might easily be taken for private houses or small apartment houses.

The Riverside exchange was the first of the real common battery exchanges. A start was made with the system at Harlem, in 1898, the existing exchange building at One Hundred and Twenty-fourth Street, which was ill-adapted for the purpose, being equipped with a plant which was more or less experimental. This exchange will shortly be superseded, lock, stock and barrel, by a new exchange equipment in a new building. The experimental common battery plant installed at Harlem in 1898 giving successful results, the Riverside building was planned as a type of common battery central office building. It is built of Perth Amboy terra-cotta brick and terra-cotta ornamentation, or "trimmings" in imitation of stone, the general treatment of the exterior being similar to that of the Dey Street building. This style of exterior has a lighter, cleaner appearance than red brick, and at the same time is not so glaring as marble and stone. The terra-cotta brick, having a hard, dense, non-porous surface, is easy to clean when it becomes weather-stained. The building is as fire-proof as modern architectural science can make it, and every possible precaution is taken to guard against fire risks, even to sheathing trap doors in the false floorings covering the cable heads with sheet iron to render them non-inflammable. The floors of the terminal room and of the hallways are of mosaic and tiling, which is fire-proof, easy to keep clean, and practically everlasting. For the flooring of the operating rooms, hard wood has hitherto been used, but rubber tiling is to be adopted in future. Although the rubber tiling costs more in the first place, it is much quieter than a wood floor, and more economical to keep clean than

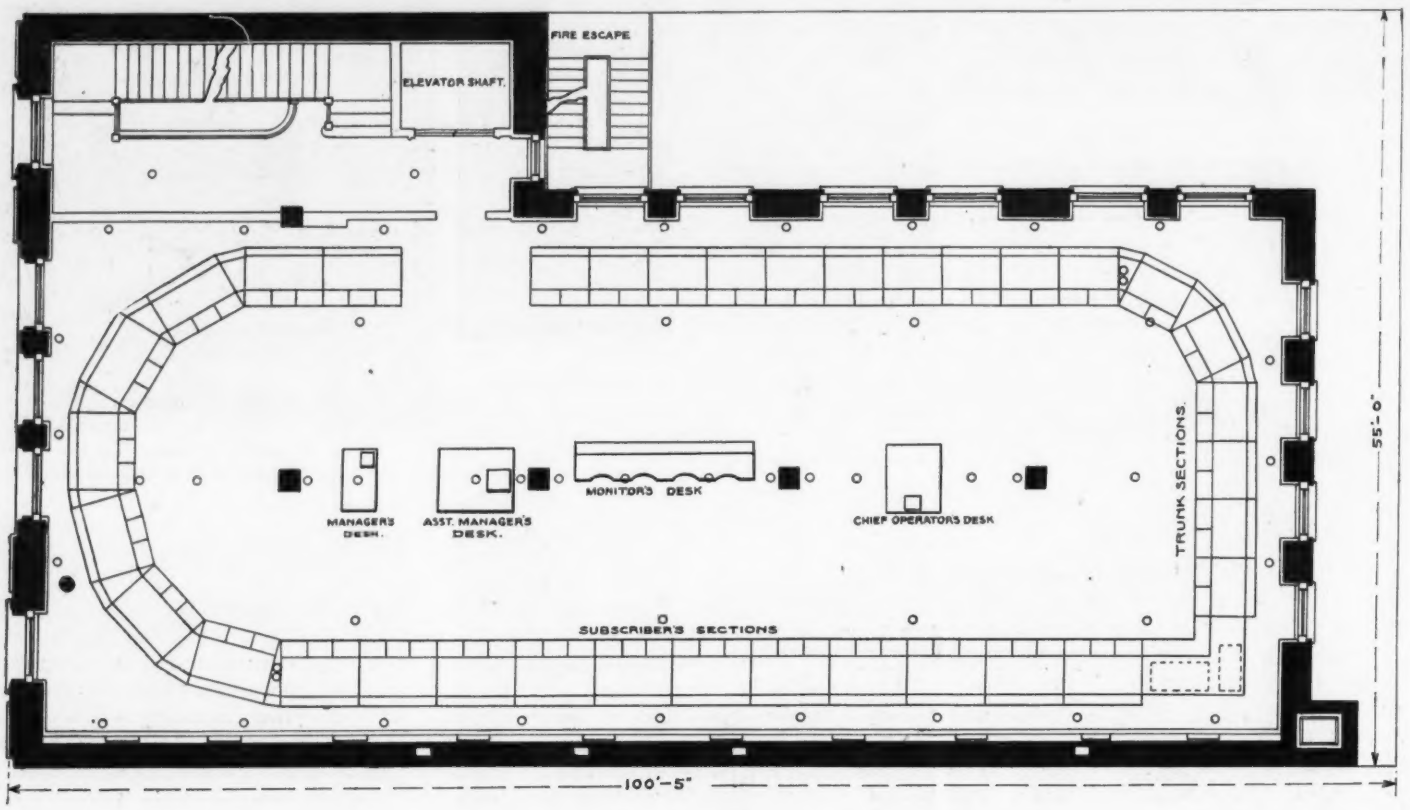


FIG. 16.—FOURTH FLOOR PLAN, PLAZA CENTRAL OFFICE.

the parquetry flooring, which requires much care and attention to keep in good condition, if there is any traffic. The stairways are of iron and marble with iron balustrades.

In planning a telephone building, there are two important points to keep forward, besides the prime necessity of rigorous fire-proof construction; these are, great strength of flooring in order to carry the concentrated weight of the terminal equipment and power plant and of the switchboard; and the greatest possible amount of unencumbered space on each floor, that is, freedom from pillars, columns, projections and recesses. The architect responsible for the New York telephone buildings has been singularly successful in meeting these requisites. In the spacious terminal and operating rooms of the new exchanges there is such a clear range of vision in all directions that one accustomed to the modern office building of the grated packing-box variety is tempted to wonder where the support comes from. The floors of the regulation office building are designed to support a maximum weight of 100 pounds to the square foot. In the telephone buildings just double this, 200 pounds to the square foot, is provided for. In the way of minor details, great care is exercised to avoid construction that will harbor dirt and dust, and to eliminate inflammable material; the walls are made entirely smooth, the ordinary wood trimming and wainscoting being dispensed with, and a marble surbase fitting tightly to the floor is substituted for the regulation wooden surbase. An additional fire precaution adopted in all the latest buildings is the adoption of metal

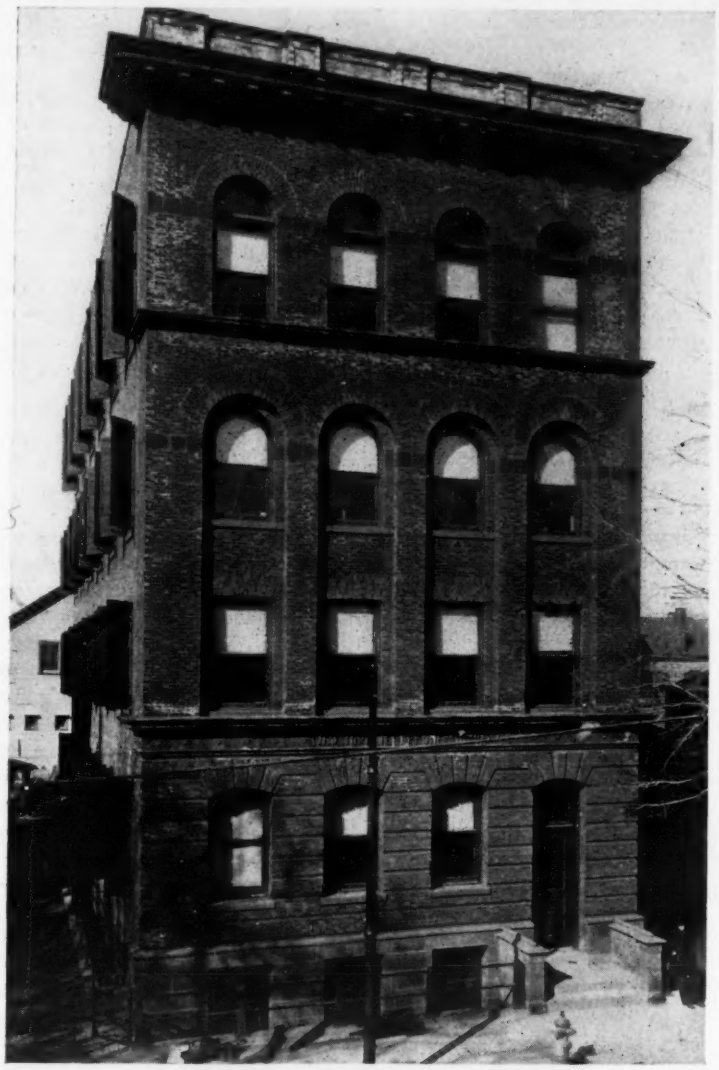


FIG. 17.—MT. VERNON CENTRAL OFFICE.

window frames, thus getting rid of one more inflammable fitting, and abolishing one risk of catching fire from the outside.

In the arrangement of the modern exchange, the old order of things has been entirely changed. The terminal room is brought down, both because its greatly enlarged equipment needs much more space than it formerly occupied, and also in order to bring the distributing board near to the exchange manhole, so as to make the house cable-run as short as possible. The drawing, which shows partly in section the arrangement of the new Plaza exchange, illustrates the most modern layout of a common battery central office. The terminal room is on the second floor, the end of the main distributing board being at the extreme front of the building. The cables are brought in from the exchange manhole in iron ducts, and are connected to the distributing board by pot-head joints, the length of cable run from the street vault or exchange manhole to

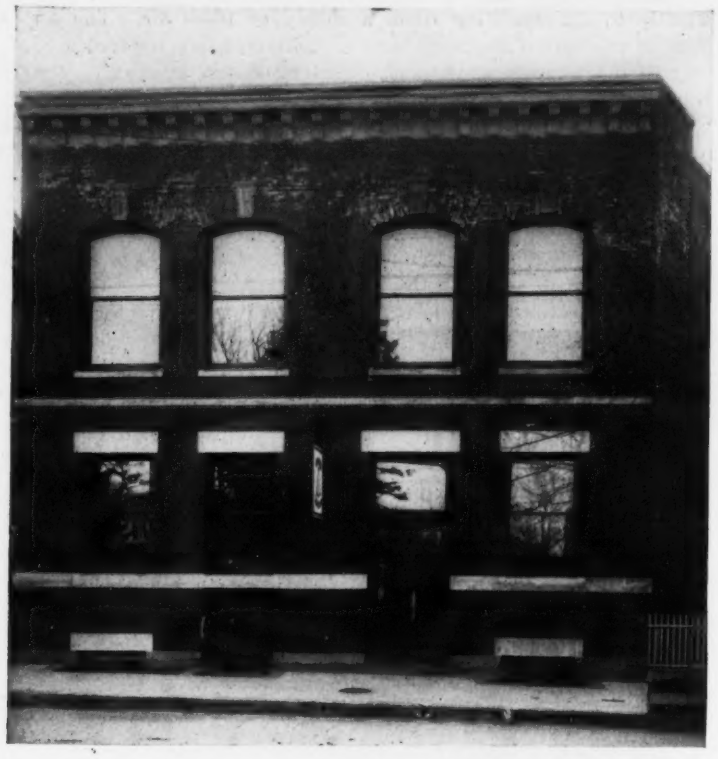


FIG. 18.—NEW ROCHELLE CENTRAL OFFICE.

the distributing board being a little over 20 feet. In the Thirty-eighth Street building, as originally equipped with the terminal room at the back of the top floor, the length of the cable run from the exchange manhole to the cable rack was about 200 feet; so it will readily be seen what a considerable gain is made in the important items of cables and house ducts by the new style of arranging a central office equipment. Following the main distributing frame, which in the drawing is hidden by the stairway and elevator shaft, come the relay racks and intermediate distributing frame, from which the house cables go up to the switchboards on the fourth floor, as shown clearly in the drawing. The two generating sets, a duplicate set always being provided for reserve, are at the rear of the room. The motor generators that furnish current for ringing, testing and signalling are mounted in a compact battery on a single bed-plate to the left, and the power switchboard and fuse panels are mounted parallel with the length of the room with a clear space in front, the storage battery running across the room at the extreme rear. The only part of the terminal room equipment not indicated in the drawing is the wire chief's desk, which, like the distributing frames, is hidden by the elevator shaft and stairway. The floor plans show the complete arrangement of each floor of the exchange. The floor above is occupied exclusively by the operators' quarters. The New York Telephone Company has always made it a practice to provide the operating staff at each exchange with comfortable and spacious quarters in which to spend the time when the operators are not on duty at the switchboard. Like other departments of the central office, these operators' quarters have steadily improved in various details, and in the newer exchange buildings they need only a little more decoration to be positively luxurious. As it is, they are eminently practical, and have the solid luxuries of perfect cleanliness, light, ventilation and spaciousness. The operators' quarters are divided into three main departments; the locker room, equipped with steel wire lockers, in which the operators keep their hats and wraps, as well as their individual telephone sets when off duty; the dining room, furnished with ample dining tables and chair accommodation, and equipped with urns from which the matron in charge supplies the operators with tea, coffee, etc., the operators providing themselves only the solid parts of their meals; and the reading room, comfort-

ably furnished to serve as a resting place for the portion of the staff off duty, and kept supplied by the company with newspapers and current periodicals. In addition to these departments there is a special room, to serve as a sick-bay in case of sudden illness, and lavatory accommodation on an ample scale. A further illustration of the care that is taken to insure the best possible conditions for the operating force is the method of ventilating the operating rooms. A ventilating plant is installed in every building, which delivers constantly to the operating room a supply of fresh air. The air is filtered to deprive it of dust, and is humidified and warmed according to the weather conditions. This results in practically perfect ventilation of the operating rooms, which, as may be easily understood, are difficult to ventilate satisfactorily by the ordinary methods of windows and skylights.

The operating room occupies the whole of the top floor, which gives a clear and spacious apartment nearly 100 feet by 50 feet, amply lighted by windows and skylight. The switchboard, as shown in the drawings, is divided into two parts, one containing all the subscriber sections, and the other all the incoming trunk sections. The equipment of subscriber and incoming trunk sections under the common battery system is so different—practically the only common feature being the multiple jacks—that in modern practice the two switchboards are made entirely separate, the multiple cables branching to each length of switchboard from a common point called a cable-

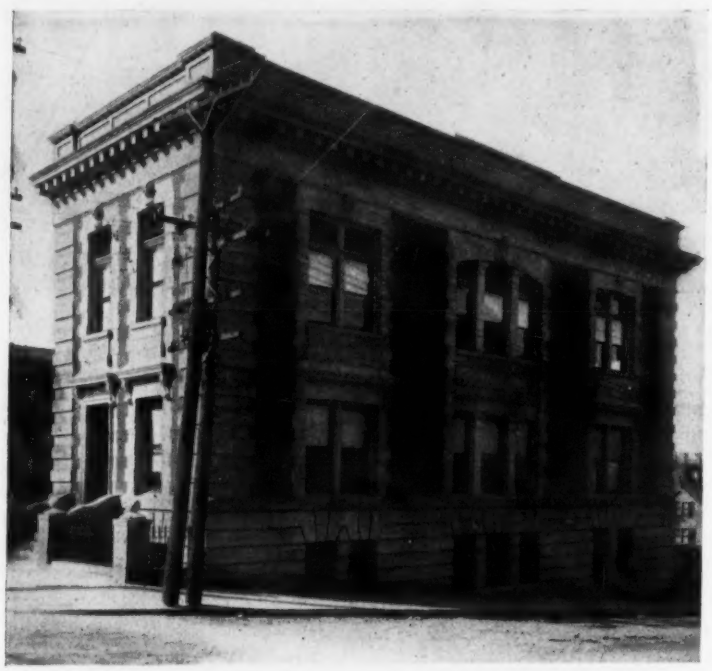


FIG. 19.—TARRYTOWN CENTRAL OFFICE.

turning section. The capacity of the Plaza exchange is 9,600 lines, about the same as that of the new Cortlandt central office recently described in ELECTRICAL WORLD AND ENGINEER, and the equipment will be practically of the same style as that installed at Cortlandt Street.

The buildings for the new Harlem, Morningside, Orchard and Chelsea offices will be of the same general type as the Plaza building, the only difference being those due to the varying size of the lots. The Chelsea building will be the largest of the five, and will be U-shaped, that being the design adopted whenever the shape and size of the building lot permit. This building will contain, besides the central office plant, the repair shop, now outgrowing its quarters at Gold Street, a laundry, and, possibly, other departments required to meet the company's varied and ever-increasing needs.

In illustration of the importance of the power plant and terminal equipment and the large amount of space now required for their accommodation, it may be mentioned that in the buildings now in service the terminal room space amounts to over 28,000 square feet, as compared with 48,000 square feet of operating room space. The terminal and power plant, therefore, now takes up nearly 60 per cent. as much space as the switchboards themselves, and the operators' quarters occupy space nearly in the same proportion. These figures show strikingly how the layout of a telephone exchange has been transformed during the last few years. The point is even more forcibly illustrated, however, by the drawings of the Plaza exchange, which show that the amount of space occupied by the operating room, terminal room and operators' quarters is practically the same. The area occupied by a telephone building has always necessarily been governed by the space required for the operating room, and when the operating room was practically the sole point to be considered as regards the telephone plant, the building was designed so that the space between the basement and the operating room could be used for offices, and rented to tenants when not required for telephone offices. Now, the telephone plant and staff require practically the whole building and a telephone building nowadays is a telephone building pure and simple. In fifteen buildings now in use, the central office equipment occupies a total of 115,000 square feet—nearly three acres of telephone exchange in a single city

North of the Harlem River there are several interesting telephone buildings, the largest and most interesting being the new Melrose building in East 150th Street. In Westchester County, Mount Vernon, New Rochelle, Tarrytown and Yonkers, all have special telephone buildings. The New Rochelle building has been in service several years, those at Tarrytown and Mount Vernon are quite new, and the Yonkers building is now approaching completion. Each of these is a telephone building exclusively, containing no hing but telephone plant and telephone offices. In each of the Westchester buildings is a branch of the contract department for attending to new business and general relations with the public, and a branch of the maintenance department. The Mount Vernon building, equipped with a common battery exchange, contains the headquarters offices of the Westchester Division, and very spacious, light and airy offices they are, arousing rather a spark of envy when one compares them with the accommodation one has to put up with in the heart of Manhattan. The Yonkers building will also be equipped with a common battery exchange. The new Melrose building merits a description by itself, as it is a highly interesting telephone building. It contains, besides a common battery exchange of an ultimate capacity of 7,200 lines to serve the Melrose district of The Bronx, a special equipment occupying a whole floor for handling the Westchester trunks, hitherto operated at a special board in the Harlem exchange. The new Westchester switchboard has several novel features, notably an automatic ticket-distributing system for conveying the toll-checks from the recording operators to the positions of the operators charged with making the connections.

Insurance on Automobiles.

Fire insurance companies are reported to be declining risks on automobiles. The president of a large fire insurance company is quoted on the subject, as follows: "To make an adequate rate on automobiles it is necessary to consider the machines under separate headings, relating specifically to the machine itself, without foreign considerations, then the increase in hazard of the building and contents containing the automobiles. To consider the question of automobiles as it applies separately to the make-up of the rate it is necessary to consider the several different styles of machines, o which, naturally, the electric machine is the safest, no appreciable hazard arising from such power. The gasoline, which is next, increases the hazard in the same ratio as to the quantity of the fluid necessary to its operation, not only in the tank of the machine itself, but to the increased hazard of the storage of the fluid and the constant dripping on the floors, making the entire contents dangerous. The steam machines are perhaps the most dangerous, as this style requires not only the presence of gasoline in bulk, but the increased hazard of the pressure tank containing gasoline under pressure at 40 to 60 pounds, by which it is forced to the burner, and the presence of the naked flame, which, should any derangement of the regulator or leak occur, would be likely to create a blaze of dangerous extent. The continued flow of gasoline when the flame is extinguished, and the method of igniting also make this system extra hazardous."

Ohio Electric Light Association.

The next annual meeting of the Ohio Electric Light Association will be held at Columbus, Oct. 14, 15 and 16. This is one of the most successful State associations, and a large attendance is expected.

The Magnetic Properties of Iron and Steel at Liquid Air Temperatures.

BY C. C. TROWBRIDGE.

LIQUID air has been the means of extending research in the various branches of physics to extremely low temperatures. Among the investigations of industrial importance that have been made are those relating to the effect of low temperatures on the magnetic properties of iron and steel. It is the purpose of this article to give a brief account of these investigations and the results obtained. A statement first in regard to the temperature of liquid air will not be out of place, and an account of the results of measurements of the peculiar magnetic property of liquid oxygen should be of interest.

THE TEMPERATURE OF LIQUID AIR.

If a quantity of atmospheric air is liquefied its temperature becomes — 191.4° C. at normal pressure. Liquid air, however, changes in composition when it is boiling, the percentage of nitrogen in it diminishing while that of oxygen increases. This change occurs because the boiling point of liquid nitrogen at atmospheric pressure is — 194.4° C. and that of liquid oxygen — 181.4° C., and the former liquid boils away at a higher rate than the latter. It follows that boiling liquid air also changes in temperature. If liquid air is allowed to boil for a considerable time its temperature gradually approaches that of liquid oxygen, — 181.4° C., but when it is used for experimental purposes its temperature is usually about — 185° C. The temperature of the liquid air is, therefore, at least 200° C. below normal room temperature, which is generally considered 20° C. This difference gives a wide range of temperature for experimental purposes. In addition, opportunity is offered of studying the properties of materials at the very low temperature of — 185° C. While considerably lower temperatures than this have been obtained by Professor James Dewar and others, research in this direction has been confined mainly within the low temperature limit mentioned.

A number of investigations on the effect of low temperatures on the magnetic properties of iron and steel have been made, liquid air being employed to cool the specimens tested to about — 185° C. These have been on the strength of permanent magnets and on magnetic permeability and hysteresis in iron and steel. The results of these investigations will be presented separately. Experiments of this nature are of industrial importance, for they will unquestionably lead to a more definite knowledge of the molecular change in iron and steel when subjected to magnetic influences. It is to such experiments that the great progress in practical electricity is primarily due. The subjects to be presented will be taken up in the following order:

1. The magnetic permeability of liquid oxygen and liquid air. 2. Experiments at low temperatures on permanent magnets. 3. Magnetic permeability and hysteresis in iron and steel at low temperatures. 4. General summary of the results of the experiments described.

MAGNETIC PERMEABILITY OF LIQUID OXYGEN AND LIQUID AIR.

The magnetic permeability of liquid oxygen as compared to that of other liquids is very high, as can be seen from the results of an investigation of Fleming and Dewar, who have studied the magnetic permeability of liquid oxygen and liquid air. They find that the magnetic permeability of liquid oxygen is 1.00287. This number is the ratio of the magnetic permeability of liquid oxygen to that of cold gaseous oxygen, and by the same method used in the given determination no difference was detected between the magnetic permeability of gaseous oxygen at — 182 C. and at normal temperatures. The value 1.0024 was obtained for liquid air, its magnetic permeability being chiefly due to the liquid oxygen it contained.

A short table is given herewith to show a comparison of the magnetic permeabilities of various liquids. The values for permeability (μ) were calculated by the use of the formula $\mu = 1 + 4\pi\kappa$ from determination of magnetic susceptibility (k) of liquids made by various investigators. The value for susceptibility for liquid oxygen is about four times as great as that for ferric chloride, one of the most magnetic of the iron salts, the magnetic permeability of which is given third in the following table:

Table I.—Magnetic Permeability of Various Liquids.

Liquid.	*Permeability* (μ).	*Determined by*
Liquid air	1.00287	F. & D.
Liquid oxygen	1.00240	F. & D.
Ferric chloride (Sat. Sol.)	1.00072	Townsend.
Manganese chloride	1.00019	Wähner.
Cobalt chloride	1.000038	"
Nickel chloride	1.000023	"
Water (D .9993)	.999993	

All of these values are, however, far below that of the so-called non-magnetic iron alloys. Twelve per cent. manganese steel, usually called non magnetic, has a magnetic permeability of 1.3 to 1.4.

An important note relating to the investigation on the magnetic permeability of liquid oxygen, by Fleming and Dewar, has been published by the authors, and is as follows: "In connection with the above investigation, it is interesting to note one remarkable difference between the magnetic susceptibility of oxygen in the liquid and in the gaseous state. The mass of 1 c.c. of gaseous oxygen, taken at 15° C. and 760 mm, is 0.00134 gramme. The mass of 1 c.c. of liquid oxygen, taken at —182° C. and 760 mm, as determined by one of us (J. Dewar), is 1.1375 gramme. Hence the ratio of the density of liquid oxygen to that of gaseous oxygen is 849 to 1.

"The magnetic susceptibility of gaseous oxygen at 15° C. and 760 mm, as obtained from the figures given by Faraday and E. Becquerel, is 0.143×10^{-6} per unit of volume, whilst the magnetic susceptibility in the liquid state is, as we have shown, 228×10^{-6}. Hence the ratio of the magnetic susceptibility of liquid oxygen to that of gaseous oxygen for equal volumes is 1594 to 1.

"In other words, the magnetic susceptibility of liquid oxygen is nearly twice as great as that of gaseous oxygen of equal masses. The inference is that magnetic susceptibility is not merely a property of the molecule *per se,* but is a function of the state of aggregation."

EXPERIMENTS ON THE STRENGTH OF PERMANENT MAGNETS.

Dewar has investigated the effect of lowering the temperature of permanent magnets to — 182° C. and determining their magnetic moments at + 15° and — 182° C. through several cycles of temperature change between these limits. Subsequently, more extensive experiments of the same nature were performed by Dewar and Fleming together. Among the conclusions reached by them are the following:

"1. That the sudden cooling to the temperature of liquid air usually permanently decreases the magnetic moment of short magnets made of many varieties of steel, assuming them to have been magnetized initially in a strong field.

"2. This initial decrease is found both in hardened steels having great coercive force and also in the same steels in a soft or annealed condition, and especially conspicuous in the case of the 19 per cent. nickel steel.

"3. In the case of most steels so far examined the effect of cooling magnets made of them to — 185° C. is to temporarily increase the magnetic moment after the permanent magnetic condition has been reached.

"4. The exceptions of the above rule so far noted are the nickel steels with percentages of nickel from 19 to 29 per cent., in which case the magnetic moment is always decreased temporarily by cooling to — 185° C. after the permanent condition has been reached."

In the experiments just referred to, performed by Dewar and Fleming, the steels tested were magnetized at normal temperatures and then subjected to temperature changes through the range + 15° to — 185° C.

The writer has recently made a series of experiments with permanent magnets which were magnetized at the temperature of liquid air. (— 185° C.) The magnetic strength of the magnets were shown by their magnetic moments determined by means of a magnetometer. The magnetic moments obtained by magnetization at approximately — 185° C. were compared with the magnetic moments of bars of the same steel obtained by magnetization at normal temperature, 20° C. The change of magnetic strength produced by heating bar magnets to 20° C. which had been magnetized at — 185° C. was determined also and compared with the change produced by cooling magnets of the same steel to — 185° C. which had been magnetized at 20° C. The experiments were chiefly confined to carbon magnet steel and

tungsten magnet steel. Among the results obtained were those given below, which are shown for convenience in tabular form.

In these experiments the initial change of magnetic strength or the first gain or loss in the magnetic moment, accompanying the first change of temperature of the bars of steel after they were magnetized was determined, because it has been shown that the change of magnetic strength of a permanent magnet due to a change of temperature depends partly on the previous history of the magnet. Special care was taken not to jar the magnets throughout the experiments, and also to determine their magnetic moments immediately after magnetization.

Three bars of carbon steel, size 83 x 10 x 3 millimeters, weighing 24.45 grammes, were heated together to a red heat and then hardened in water at 20° C. They were magnetized at —185° C. and then immediately warmed to 20° C. The magnetic moments at these temperatures were as follows:

Table II (a).—Carbon Steel Magnetized at —185° C.

Magnet.	*Magnetic Moment at —185° C.*	*Magnetic Moment at 20° C.*	*Difference (Loss).*	*Percentage (Loss).*
1	211	131	80	37.9
2	202	140	62	30.6
3	211	147	64	30.3
Mean	...	...	..	32.9

Another bar of this steel of the same dimensions and weight as the magnets 1, 2 and 3 and hardened with them, was magnetized at 20° C. and then immediately cooled to —185° C. The magnetic moments at 20° C. and —185° C. were as follows:

Table II (b).—Carbon Steel Magnetized at 20° C.

Magnet.	*Magnetic Moment at 20° C.*	*Magnetic Moment at —185° C.*	*Difference (Loss).*	*Percentage (Loss).*
4	208	189	19	9.1

It is evident that the initial loss in magnetic moment due to change of temperature when the steel is magnetized at —185° C. and then warmed to 20° C. is much greater than for the reverse operation, although in either case, a considerable loss in the magnetic moment is the result of a change in temperature of the steel of 205 degrees.

These carbon steel magnets, 1, 2, 3 and 4, were allowed to rest undisturbed for nine days at approximately constant temperature (room temperature in April). Their magnetic moments were then determined, and are given in Table III.

Table III.—Carbon Steel: Total Change of Magnetic Moment at the End of Nine Days.

Magnet.	*Original Magnetic Moment.*	*Magnetic Moment After 9 Days.*	*Difference (Loss).*	*Percentage (Loss).*
1	211	127	84	39.8
2	202	136	66	32.6
3	211	138	73	34.6
4	208	170	38	18.2

Magnets 1, 2 and 3 were magnetized at —185° C. and then warmed to 20° C. The total loss of magnetic strength of these magnets since magnetization was approximately twice as much as magnet 4, which was magnetized at 20° C., cooled to —185° C. (with a loss of 9.1 per cent.), and then warmed to 20° C. again.

Tungsten Steel from Sheffield.—Three bars of tungsten steel, sizes 89 x 2 x 3 millimeters, each weighing 5.05 grammes, were hardened together in water at 20° C. They were magnetized at —185° C., and then warmed to 20° C. The magnetic moments at the two temperatures were as follows:

Table IV (a).—Tungsten Steel Magnetized at —185° C.

Magnet.	*Magnetic Moment at —185° C.*	*Magnetic Moment at 20° C.*	*Difference (Loss).*	*Percentage (Loss).*
1	212	179	33	15.5
2	228	192	36	15.7
3	232	206	26	11.2
Mean	...	...	..	14.1

A bar of this steel, hardened with magnets 1, 2 and 3, was magnetized at 20° C. and then cooled to —185° C. The magnetic moments obtained were as follows:

Table IV (b).—Tungsten Steel Magnetized at 20° C.

Magnet.	*Magnetic Moment at 20° C.*	*Magnetic Moment at —185° C.*	*Difference (Loss).*	*Percentage (Loss).*
4	213	200	13	6.1

Bundle of iron wires (not pure iron), 9 cm. long, heated to a red heat and cooled in air at 20° C., magnetized at —185° C., and then warmed to 20° C., showed the following loss of magnetic strength:

Table V.—Iron Wire Magnetized at —185° C.

Magnetic Moment. at —185° C.	*Magnetic Moment. at 20° C.*	*Difference (Loss).*	*Percentage. (Loss).*
22.3	13.5	8.8	39.4

Another fact is shown by these experiments; approximately the same magnetic moment is produced, whether the steel is magnetized at 20° C. or —185° C., other conditions being equal. This is evident from a comparison of the magnetic moments obtained after magnetizing steel bars at —185° C., with the magnetic moment obtained after magnetizing a bar of the same steel at 20° C.

Table VI.—Carbon Steel, Magnetized at —185° C. and at 20° C.

Magnet	*Magnetized at*	*Magnetic Moment*
1	—185° C.	211
2	—185° C.	202
3	—185° C.	211
4	+ 20° C.	208

Table VII.—Tungsten Steel, Magnetized at —185° C. and at 20° C.

Magnet	*Magnetized at*	*Magnetic Moment*
1	—185° C.	212
2	—185° C.	228
3	—185° C.	232
4	+ 20° C.	213
5*	+ 20° C.	232

*5 magnetized previously at —185° C.

The writer's experiments on the magnetization of steel at liquid air temperatures seem to warrant the following general conclusions.

1. That approximately the same magnetic moment is obtained whether a bar of tungsten steel or carbon steel is magnetized at normal or at liquid temperature, other conditions being equal. This is evident from a comparison of the magnetic moments obtained after magnetizing steel bars at —185° C., with the magnetic moment obtained after magnetizing a bar of the same steel at 20° C.

2. That the initial loss in the magnetic moment, due to change of temperature, of a bar of steel magnetized at 185° C. and then heated to 20° C. is much greater than when the bar is magnetized at 20° C. and then cooled to —185° C., a considerable loss occurring in both cases.

3. That there is a certain amount of unstable magnetism in a newly made steel magnet, which tends to permanently disappear at the first change of temperature in either direction from that at which magnetization takes place, much more of the unstable magnetism passing off by heating than by cooling.

Concerning these results, Mr. F. A. Griffin makes the following suggestions, that "In the light of the molecular strain hypothesis, the fact that molecular rigidity increases with descending temperatures may explain the relative rapid recovery, *i. e.*, decrease in magnetic moment of those bars which were magnetized at lower temperatures. In other words, the strained condition of a magnetized cold bar is relatively artificial, and any rise in temperature tends to leave its molecules free to respond to the restoring action of internal stresses. It would appear that the molecular moment due to the magnetic field was large in comparison with the opposing intermolecular moment developed in the bars under experiment; this would make the magnetic moment independent of the temperature." This assumption is, of course, meant to refer to the initial magnetic moment, or

that immediately after magnetization, and it seems most probable that it would be found to be true for strong magnetizing forces, while, perhaps, not for those that are very weak.

It is necessary here to call attention to the fact that in several cases mistakes have been made by writers in stating the results of investigations on magnetism at low temperature. Among these is the following statement, taken from Thompson's "Elementary Lessons in Electricity and Magnetism." Edition of 1901, p. 104.

"Trowbridge found severe cooling at 100 degrees below zero to destroy the magnetism of steel magnets; but Dewar has observed that when cooled to —185° C. in liquid oxygen, the magnetic properties of the iron are nearly twice as high as at 0° C."

What Professor John Trowbridge found was as follows: That a bar magnet magnetized at 6° or 8° C. when cooled from 4° C. to —25° C. lost less than 4 per cent. of magnetism. For a greater reduction of temperature, to about —80° C., a far greater percentage loss of magnetism was observed. In one case a bar magnet magnetized to saturation lost 66 per cent. of its magnetism.

The latter part of the statement quoted above probably refers to an investigation of Fleming and Dewar, on the permeability of iron and steel at liquid air temperatures, the results of which are given below.

PERMEABILITY AND HYSTERESIS LOSS OF IRON AND STEEL AT LOW TEMPERATURES.

Fleming and Dewar found in an extensive series of measurements that the magnetic permeability of annealed soft Swedish iron decreased when cooled to low temperature, but that the permeability of unannealed Swedish iron increased as the temperature diminished. In the case of hardened iron, the permeability increased several hundred per cent. when the iron was cooled to liquid air temperature. These results were for both weak and strong magnetizing forces.

A steel pianoforte wire behaved the same as annealed soft iron; when a strong magnetizing force was used its permeability decreasing over 50 per cent. when cooled from 0° to —200° C.

These investigators found that for various induction densities the hysteresis loss was the same at —186° C. as at normal temperature. Curves showing affect of low temperatures on magnetic permeability of iron and steel, according to Fleming and Dewar, are given opposite.

T. Claude has also studied the magnetic properties of iron at low temperatures. According to his experiments, for high induction densities, the permeability and hysteresis loss of iron are the same at —186° C. as at 20° C., except for a slight tendency toward diminution at the low temperature.

For low induction densities the permeability and hysteresis loss diminish with the temperature to a marked extent.

A. H. Thiessen has investigated the hysteresis of iron and steel at 100° C., 20° C. and that obtained by using solid CO_2 (about —80° C.) He found that for soft wrought iron, the hysteresis losses increase with decreasing temperature when the maximum magnetizing force causes approximate magnetic saturation, and that the reverse is true for low magnetizing forces.

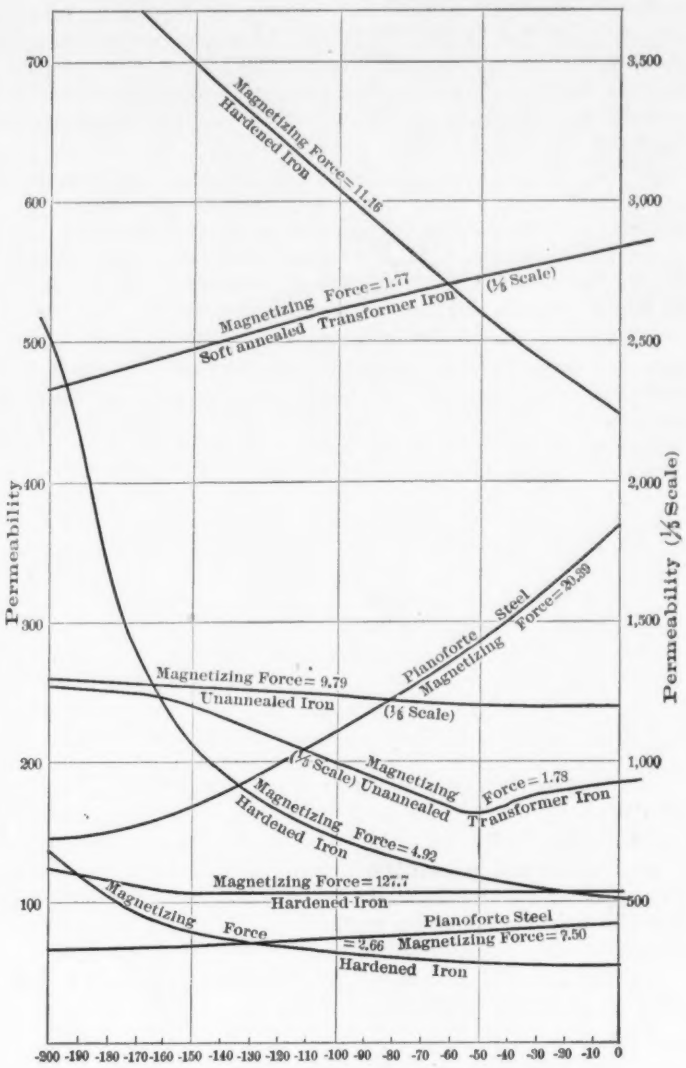
The same effects of temperature are found for annealed crescent tool steel.

In the case of 5 per cent. nickel steel, for a maximum magnetizing force, the hysteresis loss likewise increased as the temperature diminished. While these results are in agreement with previous determinations at very high temperatures, they are not in agreement with the results of Fleming and Dewar and Claude, who found that the hysteresis loss of soft iron was the same at 20° C. and about —185° C. Thiessen, however, did not experiment below —80° C. Fleming and Dewar refer to the experiments of Lows and Warren, who found that the hysteresis loss in very soft steel began to decrease only after the material was heated to above 150° C.; after that it decreased regularly in accordance with the simple linear function of the temperature.

In one experiment which Lows and Wrren tried with the same material cooled to —78° C. in solid carbonic acid and ether, they found no difference between the hysteresis loss of soft steel at that temperature and at normal temperatures.

The results of these experiments clearly indicate that determinations of the magnetic properties of iron and steel at different temperatures largely depend on the composition and the degree of hardness of the samples tested. It is most probable that the difference in the results of the experiments cited above is due to a difference in the material used in the tests and the conditions of the experiments, rather than any mistakes on the part of the investigators.

It will be difficult to formulate laws in regard to the magnetic properties of iron and steel at very low temperatures, unless the complete analysis of the material and the thermal and the mechanical treatment of the sample immediately previous to the experiment are known.



CURVES SHOWING EFFECT OF LOW TEMPERATURE ON MAGNETIC PERMEABILITY OF IRON AND STEEL.

GENERAL SUMMARY OF THE RESULTS OF THE EXPERIMENTS DESCRIBED.

The credit of the greater part of the work done thus far on magnetism at low temperatures is due to Professors James Dewar and J. A. Fleming, who have made a number of investigations together in England. Work has also been done by Professor T. Claude, in France, and the writer in this country.

A brief general summary of the results of the experiments described is given below. The investigations made, while not entirely conclusive in some cases, seem to indicate the following facts:

1. It appears that liquid oxygen has a magnetic permeability that is considerably higher than other liquids, but far below the magnetic permeability of the so-called non-magnetic iron alloys, and that, at least in the case of liquids, magnetic susceptibility is a function of the state of aggregation rather than merely a property of the molecule *per se*.

2. That the magnetic moment of a permanent steel magnet is independent of the temperature at which magnetization takes place, and that a change of temperature in either direction after magnetization will cause a permanent loss in the magnetic strength of the magnet, the amount of this loss depending upon the composition and the hardness of the steel and the number of degrees change in temperature to which the bar is subjected.

It is also evident that steel magnetized at liquid air temperature in a strong field becomes saturated magnetically almost instantly, as it does at normal temperatures. That when a magnet has been subjected to a series of temperature changes, has lost some of its initial magnetic strength and has reached a permanent condition, that cooling (to liquid air temperature) causes an increase in the magnetic moment, and that heating diminishes the magnetic moment. That steels containing 19 to 29 per cent. of nickel behave in an exceptional manner, for the effect of cooling them to —185 degrees is to temporarily decrease the magnetic moment after the permanent magnetic condition has been reached.

3. That the magnetic permeability of annealed soft iron is less at liquid air temperatures than it is at normal temperatures, but if the iron is hardened then the magnetic permeability becomes greater at the low temperature. Highly tempered steels, however, appear to behave like annealed soft iron, the low temperature having the effect of diminishing the magnetic permeability.

4. Two separate investigations have thus far been made on the effect of liquid air temperatures on the hysteresis loss in iron for high induction densities. The results obtained are in agreement and indicate that the hysteresis loss is the same at normal and very low temperatures.

Underground Work for Telephone Exchanges—I.

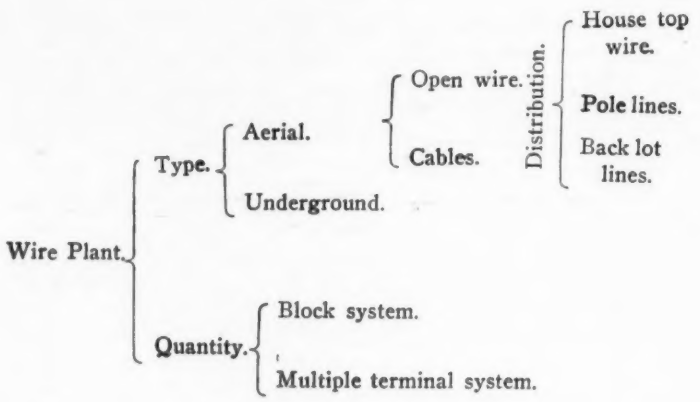
By Arthur V. Abbott, C. E.

WIRE PLANT.

STRETCHING between the substations and the central office extends the wire plant, an enormous copper net-work, outrivaling in intricacy and complexity the elaborate creations of the most ingenious of the geometricidæ. Unfortunately in the construction thereof the telephonic arachnid cannot in the least depend upon any inherited instinct like his crustaceous confrere, but must design and spin his web on what grounds of logic and probability he may, trusting to the future to justify or condemn the result.

To deal with the conducting system in a comprehensive manner, it is convenient to analyze it according to the following table:

Table No. 1.



It is now proposed to describe in a general way each of the preceding heads, to supplement these descriptions by detailed specifications under which, with such modifications as would be necessitated by changes in time and location, a wire plant could be constructed, and finally, subject to the specifications, to calculate the wire plant cost.

Considering the table, it is seen that the first subdivisions are those of *"Type and Quantity,"* The quantity of wire plant needed will depend on the area of the district, number of stations to be served and the method of distribution, but as the total cost of the plant is a question of both *Type and Quantity*—for example, underground wire if there is a sufficient amount will cost less than one-third as much per wire mile as overhead wire—it is well to commence the analysis with a consideration of the various types.

UNDERGROUND PLANT.

Historically it is hard to assign priority to either underground or aerial construction, for the original experiments of Morse on the Baltimore-Washington line were commenced with a gutta-percha covered wire buried in a trench dug in the earth. The means at the command of Morse were inadequate to secure permanent insulation, and as a temporary expedient the first telegraph line was strung on poles. Contrary to expectation this device yielded satisfactory results, immediately becoming standard practice, and—with the exception of subaqueous cables—the sole method until the middle 80's, when the introduction of the electric light and the rapidly extending use of both telegraph and telephone required the erection of pole lines of such enormous dimensions as, on the one hand, to become impractical from both a constructive and maintenance standpoint to the operating company, and on the other, an unbearable nuisance and encumbrance to city thoroughfares. Some method of relief was necessary, and the only conceivable one was that of placing the objectionable circuits underground. Early inventors attacked the subterranean wire problem from two standpoints; one class followed the example of the Atlantic cable designers, attempting to manufacture all kinds of electric conductors into cables having sufficient mechanical strength to protect the enclosed circuits from injury, either during the process of laying or subsequently thereto. On this plan the finished cable is the entire structure, merely needing to be dropped into the trench dug in the highway and covered up. Such so-called *"Built-in Systems"* have found considerable favor for telephone and telegraph installations in Europe, but in America it has appeared too difficult and too expensive to make proper cable to withstand the predatory pickaxe of the average street paver, and, further, after completion such systems are found so inelastic and lend themselves so reluctantly to any changes in distribution, that this plan has only found extensive favor with the low-tension multiple-wire distribution of the Edison companies, and in the Edison tube has reached its highest and most extensive development. For telephone work, therefore, "Built-in Systems" need no further exposition.

The other set of inventors conceived the idea that the true solution of the problem consisted in building a good substantial *"hole"* in the street into which the circuits could be introduced and removed at pleasure, and strong enough to amply protect from all outside interference the contained conductors; requiring the cable only to maintain the requisite electrical insulation. The *"Drawing-in Systems,"* therefore, while requiring a greater expenditure both initially and finally in street structures, reduce to a minimum cable cost, permit of easy rearrangement, minimize maintenance, and so have furnished a method that is sufficiently elastic to meet requirements of the service. For these reasons the various conduit systems have, with the exception of the low-tension Edison net-works, been adopted for all kinds of electrical distribution in cities of any magnitude, and their manifold advantages are causing extensions of underground wire plants into even the smaller towns.

FORMS OF CONDUIT.

From an engineering aspect, and from the broad idyllic standpoint of that which will produce the greatest good to the greatest number, the typical *"hole"* or conduit is a subterranean tunnel, large enough to permit workmen to have access from end to end, and so designed as to accommodate every form of subterranean structures—gas, water, electric wires of all kinds, steam pipes, pneumatic tubes, sewer facilities, etc., etc., that are needed in the modern city. The Parisian sewer system is the only one in which even a partial attempt has been made to approximate to this end. In all other cases the expense of such construction has made it impossible of realization without the concerted action of all parties concerned therein, and this, owing to the many conflicting interests has not as yet proved feasible; consequently, in the main, each corporation has constructed its own subway as best it might, so that it is not unusual to find one or more sewers occupying the center of a street, several lines of gas pipe and water pipe extending along either side, while the telephone, telegraph, electric light conductors, with an occasionel pneumatic tube and steam heating pipe snugly nestle together, threading their way as best they may in whatever space remains.

The problem in conduit construction is to get the best hole for the least money. As electrical conductors are universally made up in cable form, possessing a considerable degree of flexibility, rarely

over 3-in. in diameter, the unit of conduit construction becomes a single duct, capable of accommodating one cable. In earlier days the plan of building ducts capable of containing several cables side by side gained considerable currency. So far as the introduction of the cable was concerned, no difficulty arose, but after a duct was filled with, say, three cables or more, and subjected for a considerable time to the impacting influence of the debris that in a most astonishing manner finds its way in the tightest conduit, it became a difficult or almost impossible matter to remove one cable without injuring or destroying the sheathes of the others. Thus, experience has declared itself so emphatically and unhesitatingly in favor of the individual cable space that no other form should for a moment be considered.

The present method of conduit building, therefore, resolves itself into obtaining a pipe-like structure or conduit material capable of enclosing the cable, making the necessary excavation in the street in which the ducts may be laid, the placing of the ducts in such a position as to produce a series of long longitudinal tubes, the protection of the duct material by some substance that shall resist the onslaughts of the ignorant pick and shovel, the refillment of the excavation and replacement of the paving.

The ideal conduit should be moisture proof and gas tight. It should be indestructible when laid in street soil, strong enough mechanically, so that the Tammany street paver may pick away at it until he is tired without inflicting any injury, easily, rapidly and cheaply laid, and while the ducts should present a smooth surface to the introduction of the cables, they must contain no substance that can injure the lead sheath. Finally, high electrical insulation is desirable as a protection against the electrolysis of the cable sheath, due to parasitic electric currents. There is no subway that perfectly fulfils all these conditions, though each conduit manufacturer optimistically claims that his particular brand will, but there are a multitude of different makers that in varying degrees realize a portion of the preceding conditions, while all of the manufacturers now offer a material which the telephone engineer may safely use, and which if carefully selected, and installed under rigid specifications, will yield a subway that is of practical utility in all respects—the selection between different duct material makers depending chiefly upon the relative prices quoted by their respective agents.

New York State Electrical Laboratory.

At the recent session of the New York State Legislature, an act was passed providing for the appointment of an Electrical Commission to investigate as to the necessity for the establishment of a State Electrical Laboratory, to provide independent, authoritative information on questions of electrical science, and an official standardizing laboratory for electrical measuring instruments, apparatus and standards for the protection of municipalities and the general public in the use of electrical energy and of the producers of electrical energy. The commission was directed to report to the Legislature at the opening of the session of 1903, and if, in their judgment, the establishment of such an electrical laboratory is necessary, to prepare and submit in connection with their report, detailed plans and specifications for the construction and equipment of a laboratory, accompanying the plans with a specific and detailed statement of the cost.

To carry out the provisions of this act, State Engineer Edward A. Bond, Mr. Charles P. Steinmetz, of the General Electric Company, and Mr. Harold W. Buck, of the Niagara Falls Power Company, were appointed the members of the Commission. Under date of August 15, the commission issued a circular letter asking for an expression of opinion from members of the electrical profession as to the proposed institution, its scope, organization, equipment and location, which we reprint below:

With the extension of the uses of electrical energy, which is rapidly taking place, public and private interests become more and more dependent upon electrical operations, and the need for an official institution, authoratative by its high standing and government relationship, becomes evident, to serve as arbitrator in disputes arising from conflicting interests, and for purposes of standardization.

The following is the capitalization of corporations in New York State engaged in business involving the use of electricity:

(*a*) Electric railroads, electric light and power stations, telegraph and telephone companies	$1,462,615,595
(*b*) Companies engaged in the manufacture of electrical apparatus	217,974,695
Total	$1,680,590,290

From these figures an idea can be obtained of the importance and extent of the interests involved.

In the present status of the distribution of electrical energy, disputes arise, among other causes, from the following:

1. From mutual induction, static or magnetic, between independent circuits, especially between circuits carrying large currents or high potentials and circuits used for the transmission of intelligence, such as telephone, telegraph, fire-alarm, railway block signals, etc.

2. Accidents to life resulting from conditions frequently not clearly understood at the time of accident, such as crossing of circuits, failure of insulation, etc.; also from insufficient warning notices on circuits of dangerous potential.

3. Between producers of electrical energy and public consumers, such as municipalities in street lighting contracts, involving the quantity of light supplied, the trouble arising from lack of officially standardized photometric methods.

4. Between producers of electrical energy and public and private consumers on the quantity of current or energy supplied, resulting from inaccuracy of meters or methods of measurement.

5. From electrolysis in railway and other grounded systems.

6. From risk and damage to property from fire caused by defective insulation of circuits.

7. Between producers and consumers of electrical energy and Fre Insurance Underwriters on methods of installation.

8. Between independent interests having adjacent distributing circuits under ground from damage caused by heat in short-circuits in conduits and subways.

9. From damage caused by explosions in subways and conduits.

10. Between manufacturers of electrical apparatus and purchasers on guarantees for electrical performance.

11. Between producers of electrical energy and municipalities on the subject of transmission voltage of overhead circuits.

12. Between the producers of electrical energy and the general public in cases of rights of way for very high voltage transmission lines where danger to life and property is claimed.

13. Between the general public and manufacturers of electrochemical products where destructive fumes and gases are claimed to be set free in the process of manufacture.

14. Many other cases which will undoubtedly arise as the art advances, such as interference in wireless messages.

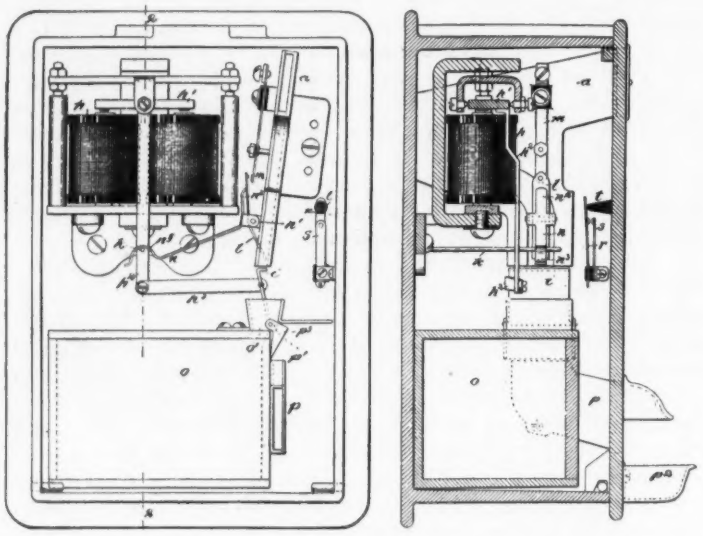
At present, all such disputes, when brought to issue, are settled by the courts, the decisions being based largely upon expert testimony, given by those who may or may not state with accuracy the facts involved. For such expert testimony large fees are required, which add greatly to the cost of settlement, and this obtains even in cases of the most simple and obvious decision. No authority exists which can be recognized by the courts as official, nor any institution where the points involved in such disputes could in many cases be made the subjects of actual demonstration by experiment.

In the establishment of a New York State Electrical Laboratory (which could serve as a precedent for similiar institutions in other States), it is proposed to organize an institution of the highest efficiency and widest scope, which shall be capable of dealing in an authoritative manner with all problems which may arise in the mutual interests of the people of the State; to have its equipment such that all phenomena in question can be reproduced on a large scale, and results under various conditions demonstrated; to have a complete set of standards for the calibration of all types of electrical meters; to have an electrochemical laboratory for demonstrations and analysis; to have the location of the institution such as to be central in the State and near to some large source of power, from which several thousand horse-power can be drawn at times for experimental purposes by a special transmission line; and, last, to have the institution presided over by a man of high standing and ability, assisted by a corps of competent assistants, who can carry out the work which will be called for by the people of the State, for merely its cost.

It is not the intention to have this State laboratory conflict with the Natural Bureau of Electrical Standards, at Washington, but to have it co-operate with it and attend only to such local matters in the State, which can more properly and conveniently be handled within the limits of the State.

Coin Collecting Telephone Stations.

The increasing popularity of message rate telephone service has created a lively demand for a satisfactory automatic coin-collecting box, which will enable the telephone user to pay as he goes, and will do away with the expensive and complicated machinery of accounting and collecting necessary in credit or even in paid-for-in-advance transactions. An automatic public station has always been an urgent need. Two recent patents bearing on this subject are of sufficient general interest to telephone men to merit somewhat extended description. Patent No. 704,268, issued July 8, 1902, to Joseph J. O'Connell, of Chicago, and assigned by him to the Western Electric Company, covers a coin-collector for telephone toll lines, and is an improvement on Patent No. 665,874, granted January 15, 1901, to Albert M. Bullard. In the Bullard device, the central office can be signaled from the subscriber's station only by the deposit of a coin in the toll-box, the coin serving to close together two contacts which control the circuit through the line-indicating device at the central office. The coin remains in the chute until the operator at the central office has ascertained whether or not the desired connection can be made, and an electromagnetic coin-distributing apparatus is provided whereby the operator may cause the coin at the subscriber's station to be either deposited in the cash-box; or in case the connection cannot be had, released and discharged from the toll-box through a return-chute. For this purpose a polarized electromagnet is employed whose armature is normally maintained in a central position, but is adapted to be tilted to one side or the other, according to the direction of the current flowing through the magnet-coils. The tilting armature is connected by lever mechanism with a swinging valve, which is located at the lower end of the coin-chute. The valve is normally maintained in a central position under the discharging end of the coin-chute, and acts as a stop against which the coin strikes in rolling down the chute, so that the coin is held at this point until the valve is moved out of the way. If the valve is moved to one side, the coin is allowed to fall out of the chute and is discharged either into the cash-box or into the return-chute, according to the side to which the valve is moved. The coils of the polarized coin-distributing electromagnet are included in a branch circuit to ground from one limb of the telephone line at the substation; and positive or negative current from a suitable grounded source at the central office may be thrown on the line by the central office operator to cause the magnet to attract its armature to one side or the other, according as



FIGS. 1 AND 2.—O'CONNELL COIN TELEPHONE STATION.

it is desired to deposit the coin in the cash-box or to return it. This grounded branch at the substation in which the magnet is included is also a portion of the circuit of the line-battery which operates the line indicators, and the two contacts before referred to, which are closed together by a deposited coin, control the continuity of the said grounded branch.

In order that the circuit through the coin-distributing magnet may not be broken and the armature of said magnet caused to flutter when the coin is released from the chute, Mr. Bullard provides a shunt around said contact, the shunt being controlled by relay contacts operated by the armature of the electromagnet, so that when the armature is thrown to one side and the coin released, the circuit through the magnet will not be interrupted, but a path for the current will be afforded by way of the shunt. In the O'Connell invention, the shunt is dispensed with, and, instead, mechanical means are provided whereby the two contacts which are initially closed together by the deposit of a coin are maintained in contact independent of the coin after the latter has been released.

Referring to the drawings, Fig. 1 is a view in elevation of the toll-box, Fig. 2 is a transverse vertical sectional view of the device

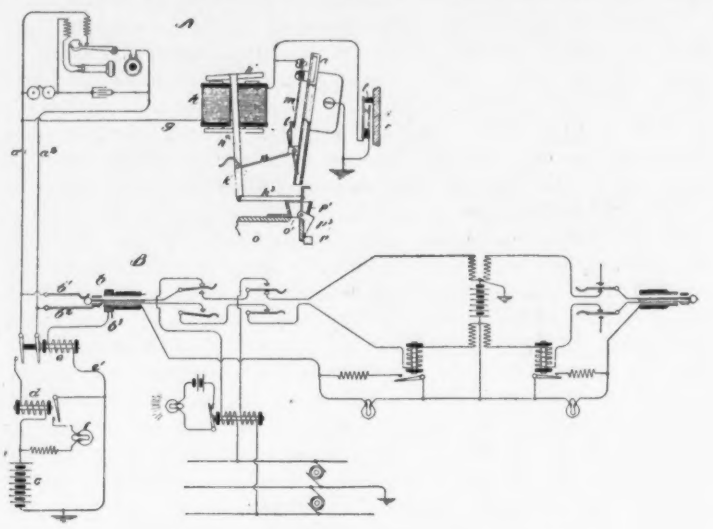


FIG. 3.—O'CONNELL COIN TELEPHONE STATION.

in Fig. 1; and Fig. 3 is a diagram of the circuits and of the principal parts of the coin-collecting mechanism. The central office apparatus shown in Fig. 3 is of the usual common battery system, with the addition of means whereby the operator can put either positive or negative current to limb a^1 of the telephone line. This line is connected at the substation with a grounded branch circuit, g, which includes electromognet h, and is normally open, being controlled by the coin-actuated contacts l m. The closing of these contacts may also be effected by the armature of h. The closing of l m energizes the line relay by grounded battery c, and signals the central office.

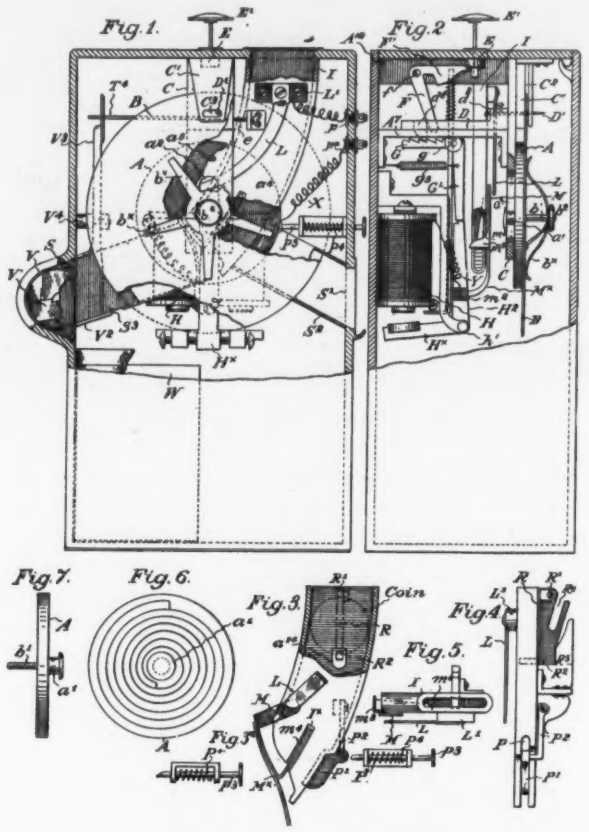
The coin-chute a is normally closed by the valve i, so that a coin dropped in a will be stopped at its lower end by the edge of i, which is pivoted so that it may be rocked by the armature h^1 connected to i by the rod h^2 and link h^3. A spring, k, fastened at the rear of the box, passes through h^2 and holds it and h^1 in a central position. Of the contacts l m, m is stationary and l is a rocking lever pivoted at the side of a with its end normally projecting into a so as to be in the path of the coin. The stationary contact, m, insulated from a, is connected to the branch g through h, and the rocking contact l is grounded. When a coin is dropped into a it brings up against i and presses on l, throwing its upper end against m and closing the circuit.

The means for mechanically maintaining m and l closed when the coin has passed the lower end of l consist of a cam-lever, n, pivoted at n^1 (Fig. 1), concentrically with l, having an upper curved end, n^2, engaging the upper end of l and a lower end, n^3, bent into cam shape and resting on the end of the spring k, passing through h^2. When h^2 is moved either to the right or left, k will bear on the cam surface, n^3 and so exert pressure at n^2, maintaining l in contact with m. If the armature of h is tilted to the left moving h^2 to the right, valve i is moved to the right and the coin is released from a into o^1 leading to the cash-box o. If h^1 is tilted to the right, i moves to the left, and the coin is guided into the return-chute p and the return-cup p^2, accessible to the subscriber. During either movement cam-lever n maintains l in contact with m. A swinging guard, p^3, may be fitted in the return-chute to prevent the insertion of a wire for the purpose of interfering with the mechanism.

A patent granted to James B. Gill, of San Francisco (Reissue No. 12,015, July 22, 1902), covers a toll-collecting device of a more ambitious character than the machine due to Messrs. Bullard and O'Connell, but the instrument is of immensely more complicated construction, and is of uncertain practical value. The Gill

device is both toll-collecting and call-recording, but since it operates with a coin of but a single size, being apparently designed for nickel service, it would seem that the call-recording mechanism is almost superfluous, as the number of coins collected, barring trickery, would indicate the number of effective calls made.

The principal points of Mr. Gill's machine are: First, that it records the calls by means of a rotating card on which the calls are marked by means of a punch, the recording device being controlled



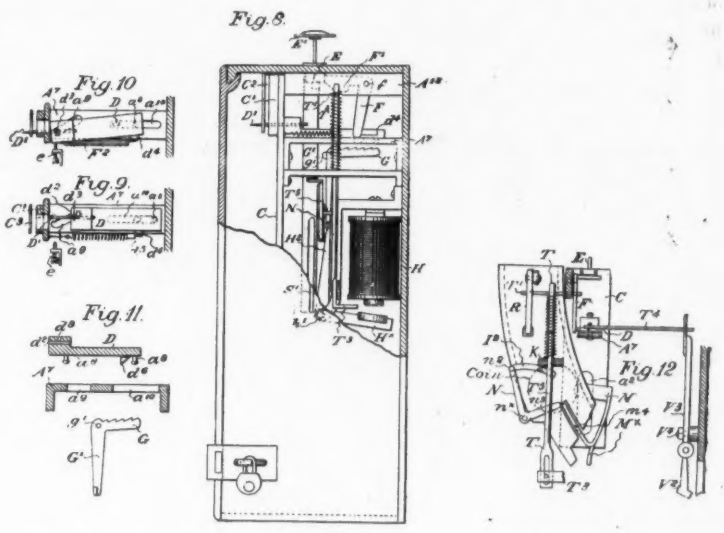
FIGS. 1 TO 7.—GILL TOLL COLLECTING AND CALL RECORDING DEVICE.

by the central office operator and being dependent on the insertion of a coin of given value in the box. It also rejects and discharges a coin inserted in the box which differs in size or value from the standard coin with which the machine is constructed to operate. It places the coin under the control of the operator to be either discharged or deposited, and it exposes the coin to view for inspection on its way to the coin receptacle. With so many objects to fulfil, the device is naturally a complicated one; indeed it has almost as many parts as a typewriter. In this respect it fails to meet an important requirement of coin-collecting boxes, viz., simplicity. While one would not venture to predict any very widespread adoption of Mr. Gill's device ,it has a sufficient number of novel and ingenious features to merit at least a detailed description.

The drawings show the various parts as follows: Fig. 1 is a front elevation of the recording mechanism, the front of the box being removed, and parts of the record card and mechanism being broken away and shown in section to expose parts in the rear. Fig. 2 is a side elevation taken from the left-hand side of Fig. 1. Fig. 3 is a detailed view, in front elevation, of the coin-chute and parts of the electrically-controlled mechanism, operated from the central office, to drop the previously inserted coin, the upper portion of the coin-chute being shown in section. Fig. 3a is a top view in detail of the push-rod P^3. Fig. 4 is a detailed view of the same parts, taken from the back of the coin-chute. Fig. 5 is a top view of Fig. 3. Fig. 6 is a back view of the rotatable disc, and Fig. 7 an edge view of Fig. 6. Fig. 8 is a side elevation of the device, taken from the right-hand side of 1, with the enclosing box partly broken away. Figs. 9 and 10 are top views in detail of the marking device in two portions, Fig. 9 showing it drawn back and set for operation, and Fig. 10 representing its position at the end of its forward throw after it has marked the card. Fig. 11 is a side view in detail of the slide, the stationary support, and the locking lever of the marking device. Fig. 12 is a rear view of the coin-chute, illustrating an attachment that is combined for operation with the other mechanism to close the contact springs in the circuit of the controlling magnets when the coin is too light to act on the springs.

The disk A, carrying record-card B, clamped to it by b^x, is mounted on pivot a^1; A rotates on the pivot, and the pivot is capable of a rectilinear movement, so that a marker held against the card while it is rotated will produce a continuous spiral line. The pivot a^1 works in a slot, a^2, in bracket C, and on the rear of disk A is a spiral groove in which pin a^5 works, producing an upward movement of the pivot a^1 in the slot a^2 and the consequent spiral mark of the pointer on the card. On C is a block, C^1, having a vertical slit to admit rim of card B, and a horizontal slot, C^2 to permit the movements of the punch, D^1, by which the calls are recorded on the card. So far, Figs. 1 and 2. Turning now to Figs. 9, 10 and 11, which illustrate the recording device, D is a slide bar mounted on bracket A^7, so as to slide thereon at right angles to the plane of the disc, studs a^8 a^8 working in slots a^9 a^{10} in A^7. The bar D carries needle D^1, which projects through slot C^2 when D is moved forward. Besides puncturing the card, D^1 moves it forward at each throw by means of a sideways movement of D^1, obtained by setting the front guide-slot, a^9 at an angle, so that the front end of the slide will be moved at an angle, the rear end swinging on the stud a^8. The effect of this lateral movement is that D^1, besides puncturing the card, moves it forward, so that the punctures are evenly spaced on the card. The slide-plate D is set by push-button E^1, working by head E on bell-crank lever F, the lower end of which bears on lug d^4. The slide is pulled forward by spring F^2, and held in place by the dog, d^6, engaging in the ratchet G on lever G^1; the spring g^3 holds G against d^6. The ratchet G by means of its member, G^1, is controlled by the armature H^x of magnet H. When H^x is attracted, arm H^2 will tilt G^1 and release G from d^6, allowing slide D to be pulled forward by spring F^2, causing D^1 to pierce the card. The normal position of D is forward; it is set by pushing the button E^1, and can then be released only by the action of magnet H, which is controlled by the operator.

At the subscriber's station the circuit is normally open, and is closed by the coin, so that the relay cannot be energized until the coin is in, and then only at the will of the operator. The two springs L M form the contacts of the relay circuit; they are in the chute so as to be acted on by the coin (see Figs. 2, 3, 5 and 8). Spring L is on front of chute I, insulated from it by block L^1; M is secured to block M^x on lever H^2 of the relay armature, M^x being insulated at m^2, and carrying a wedge m^4, setting through slot I^x in I, so that the coin striking wedge m^4 will press M out into contact with L. M^x



FIGS. 8 TO 12.—GILL TOLL COLLECTING AND CALL RECORDING DEVICE.

has also a lip, m^3, standing across the chute, so that it will hold the coin in the chute until the armature is attracted and H^2 moved. M^x thus acts to close the circuit at L M, so that H may be energized and lip m^3 retains the coin until the armature lever by a further movement of M^x causes it to be withdrawn and allow the coin to proceed.

The coin-discharging mechanism, by means of which coins differing in size or value from the standard coin can be ejected, consists of an opening, P, in the chute and a gate, P^1, operated by push-rod P^3, having a wedge-shaped end setting in line with the rear face of

P^1, so that the movement of the rod will force P^1 away from the slit, P^1 is restored by hinged lever P^2, and P^3 by spring P^4. Trough S^2, leading from I to slit S^1 in the side of the box, discharges the coin when P^1 is opened.

To insure the proper cycle of operation, the deposit of a coin and the depression of button E^1, a cut-off R is connected with E^1, closing the chute when E^1 is up, and opening it when E^1 is depressed. This cut-off (shown in Figs. 3 and 4) consists of latch R pivotted to I at R^1, and having end R^2 working through slot a^{14} in I, so as to lie across the coin passage. In the upper part of R is an inclined slot, R^4, to take a cross-pin, T^4, that is fixed in an upright rod, T, working in guide K. One end of cross-pin T^4 works in the slot, R^4, and the other is under support of lever F, projecting in path of projection F^1 on the horizontal arm of lever F. Thus push E^1 while acting on F to set slide D also draws R back from the coin-passage at the same moment; the latch R is restored to place when E^1 is released by the spring R^6. Rod T terminates in foot, T^6, adapted to strike armature lever H^x (Fig. 8). The rod T thus serves the double purpose of releasing latch R to open the chute and of forcing H^x away from H should it be held by residual magnetism.

The coin pocket V, with glass front V^1 (Figs. 1 and 12), enables the last deposited coin to be seen before being dropped in the receptacle W. The outlet is controlled by a swinging gate, V^2, held forward by gravity, and moved away by the action of arm T^4, attached to slide D. When D moves forward, T^4 tilts lever V^3, pivoted at V^4, and so retires the gate V^2, carried on its lower end; this allows the previously deposited coin lodged in V to drop through, clearing V for the one just dropped in the chute.

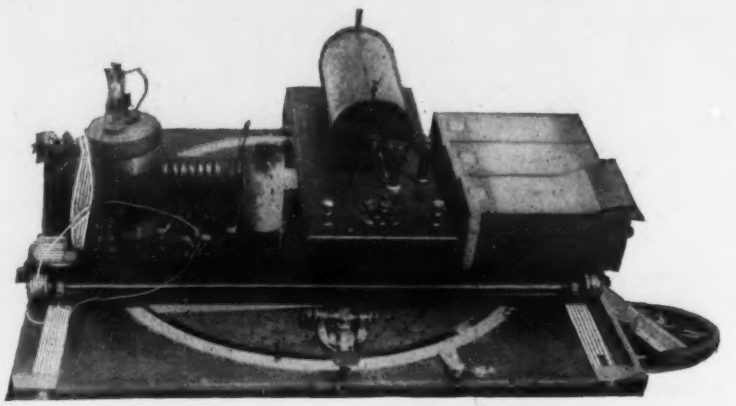
Fig. 12 shows the arrangement for insuring the proper movement of wedge m^4 in the presence of a coin of too light weight to act properly. Lever N, pivoted at n^x to back of I, has a pin, n^2, crossing the chute I and working through a slot, I^2, so as to lie across the coin-passage, and an angular member, n^3, in the path of a pin, T^6, in in rod T. Pin T^6, when I is depressed engaging lower limb of N, will throw pin n^2 in slot I^2 against the edge of the coin with sufficient pressure to push the coin against m^4, and so cause the contacts $M\,L$ to be closed. This attachment is designed to be used only in cases where coins of light weight may be dropped in the box, and under all other conditions it may be dispensed with.

The operation of the device is as follows: After the coin is inserted in the box and the push-button is pressed down and released, the coin drops into the lower part of the chute, where by contact with the wedge m^4 it throws the spring M against L. The same movement of the button sets back the slide D ready for action, and the magnet circuit being closed at $L\,M$ by the coin, the lever G^1 will trip the ratchet G holding the slide as soon as the central office operator throws battery on the relay H. By that operation the needle is projected against the record card and punctures it. In this movement the lateral throw of slide D causes B to turn on its center a short distance, according to the extent of the lateral throw of the needle. The disc is, therefore, turned slightly forward at each puncture. When E^1 is again pressed, D is drawn back and set for the next operation. In that movement the needle is withdrawn from the card without moving it, as the amount of penetration is only sufficient to cause the needle to engage the card enough to turn it, and the resistance of the fixed pin engaging the spiral groove at the back of the disc suffices to prevent the card from being turned back by the retraction of the needle. A relatively small disc can be made to contain a considerable number of record marks by giving the disc an upward movement in a vertical plane, in addition to its rotary movement, as already described, so that the line of punctures made by the needle will run in a continuous spiral line, beginning at the circumference and decreasing in size as it runs toward the center. In this operation also the necessary coin to pay for the call is retained in the chute until the operator is ready to give the required connection, and is released by the movement of the armature lever that causes the call to be recorded.

Mr. Gill has certainly produced a coin collector that is a marvel of ingenuity. Whether all the various functions that it performs are worth the elaborate mechanism required to carry them out; whether such a complicated mechanism will stand the hard use of an active pay-station, and whether the limitations of a single size of coin—which is apparently an inherent feature of the device—will not seriously interfere with its extensive adoption are questions that only practical experience can decide.

Fessenden Wireless Telegraph Apparatus.

In our issue of last week, an account appeared of a number of patents on wireless telegraphy, issued to Prof. R. A. Fessenden, and we are enabled to present herewith an illustration of a receiving and transmitting apparatus embodying in practical form some of the features covered by the patents. The apparatus shown combines a



FESSENDEN WIRELESS TELEGRAPH APPARATUS.

complete sending and receiving outfit, which has been in daily use in working between Hatteras and Roanoke, a distance of 50 miles.

It gives a spark of 1/32 inch when attached to the vertical wires, which are 140 feet long. No transformers or Thomson-Tesla coils are used in circuit. The speed of sending has been 35 words per minute, and the apparatus will operate over a distance of 100 miles.

The Value of Telephone and Telegraph Investments.

Some weeks ago comparative data was presented in these pages to establish the values of telephone and telegraph stocks; in other words, an effort was made to arrive at an idea as to the relative value, net earning capacity, etc., of American Bell Telephone, Western Union and Postal Telegraph securities. An interesting discussion has arisen over these figures, and Messrs. Moffat & White, the New York specialists in telephone securities, takes issue with the Boston *News Bureau* in respect to the value of American Telephone and Telegraph stock.

The main point of controversy is in the assumption made in the article referred to that $45 is the average gross ea nings per telephone subscriber throughout the United States. Messrs. Moffat & White have compiled statistics embracing eleven of the telephone sub-companies, showing that the average is $54.87 in the cases named, which, they say, may be taken as fairly indicative of all. The eleven companies used in calculating the averages were Chicago Telephone Company, New York and New Jersey Telephone Company, Bell Telephone Company of Pennsylvania, Central District and Printing Telephone Company of Pittsburg, Bell Telephone Company of Buffalo, Hudson River Telephone Company, Cumberland Telephone Company, Missouri and Kansas Telephone Company, Nebraska Telephone Company, Rocky Mountain Telephone Company, Colorado Telephone Company.

The averages determined by the statistics of these companies are as follows:

Average gross earnings per subscriber	$54.87
Average percentage of operating expenses to gross earnings	73.16
Average percentage earned on stock	8.71
Average rate of dividends paid	7.09

With this basis, Messrs. Moffat & White contend that the conclusions and deductions made must be amended, assuming that the eleven companies named are fairly representative of all.

Following are calculations by Messrs. Moffat & White:

Gross earnings estimated	$33,798,000
Expenses and interest	22,649,715
Net earnings	$9,915,583
Dividends paid	5,050,023
Surplus	$4,865,560

Messrs. Moffat & White may be nearer correct, says the Boston *News Bureau*, as to the average amount paid per subscriber, but it submits that while its own figures may be too conservative, those above given are too large, and it has, therefore, prepared a larger table of telephone statistics, given below:

Name of company.	Subscribers.	Gross revenue.	Gross expense.	Div. earn.	Div. paid.
Cumberland	$66,806	$2,642,563	$1,889,766	$9.53	$7.00
Wisconsin	21,363	880,303	559,407	....	....
Missouri & Kansas	17,691	1,056,638	816,791	8.24	6.00
Southern New England	14,630	813,063	607,053	6.43	6.00
Chesapeake & Potomac	12,147	846,768	736,938	5.24	4.00
New York & Pennsylvania	9,873	394,322	315,291	1.98	3.00
Pennsylvania	17,925	426,125	300,579	4.10	5.00
Central New York	4,855	258,791	239,209	2.03	3.75
Colorado	14,412	858,820	623,550	9.70	6.00
Southwestern	41,199	1,617,675	1,144,241	....	....
Northwestern	22,155	1,014,388	541,439	....	....
Cleveland	14,887	601,024	387,060	....	....
Rocky Mountain	7,289	522,989	347,417	10.97	6.00
Nebraska	13,735	754,971	603,050	9.17	6.00
Central Union	85,920	2,584,790	1,956,800	6.92	....
New England	84,325	5,177,412	3,913,805	6.19	6.00
Sunset, estimated	59,875	.....	.....	21.33	6.00
Chicago	44,962	3,775,002	2,691,129	12.04	12.00
New York & New Jersey	38,653	3,376,433	2,397,252	9.51	7.00
Michigan	46,846	1,333,260	1,126,084	....	....
Total or average	*$579,673	$29,933,337	$21,195,860	$7.71	$5.23
* Not including Sunset.					
Per subscriber		$51.54	$36.50	..	..
Per cent. expense			70.83	..	..

Subscribers all companies Dec. 31, 1901, 1,030,647.

The above table would seem to call for a revision of both estimates, and until some details can be shown to prove the calculation erroneous, it might be safe to revise the figures of the previous article on a basis of $50 as the average payment per telephone subscriber in the United States, instead of $45. In data compiled and published on this subject by one of the editors of ELECTRICAL WORLD AND ENGINEER, the average for the country has been given in these columns as $40 per year.

A slightly different calculation from the previous one, revising the amount of stock outstanding is given by the *News Bureau*. As the earnings of the telephone companies are for the last year, the capital stock should not include new shares, which do not issue until next year.

The amount of capital stock of the American Telephone and Telegraph Company at the close of the last fiscal year was $114,858,400, and the amount outstanding in the hands of the public was $82,748,000, the balance being held in the treasury of the old Bell Company, which is now practically all owned by the American Telephone and Telegraph Company. Taking the amount of stock and bonds outstanding at the close of the year, we may compare the capitalization of the telephone company with that of the Western Union and of the Commercial Cable, as follows:

	Am. Tel.	West. Un.	Com. Cable.
Stock outstanding	$82,748,000	$97,370,000	$13,333,300
Bonds outstanding	25,000,000	19,660,000	20,000,000
Total capital	$107,748,000	$117,030,000	$33,333,000

The total selling values of the companies in the market, taking the bonds of all three companies at par, compare as follows:

	Am. Tel.	West. Un.	Com. Cable.
Price of stock	165	90	160
Market value of shares	$136,534,200	$89,933,000	$21,333,280
Bonds at par	25,000,000	19,660,000	20,000,000
Total selling value	$161,534,200	$109,293,000	$41,333,280

The gross Bell telephone business of the United States at $50 per subscriber would be about $51,500,000. Of this amount about $3,500,000 represents the direct gross business of the parent company, and one-half the remainder, or $24,000,000, its share in the gross business of the sub-companies. Of the latter amount 71 per cent. may be allowed for disbursements before dividends of the sub-companies, leaving $6,960,000 as the parent company's share in the net earnings of the sub-companies. A former estimate was $7,000,000.

The parent company last year received in dividends $4,988,207. The undivided earnings in the treasuries of the sub-companies, therefore, amounted to $1,971,793. The parent company reported net earnings from traffic rentals and from dividends paid as $7,398,285. The total net earnings of the parent company, therefore, adding in the undivided earnings in the treasuries of the sub-companies, amounted to $9,370,078. On this basis we may compare the operations of the American Telephone and Telegraph Company with those of the Western Union (year ended June 30, 1901) and the Commercial Cable (year ended Dec. 31, 1901), as follows:

	Am. Tel.	West. Un.	Com. Cable.
Gross (estimated)	$30,181,353	$26,354,150	$3,592,129
Expense and interest	20,811,275	20,625,062	2,061,166
Net	$9,370,078	$5,729,088	$1,530,963
Dividends paid	(7½%) 5,050,023	(5%) 4,868,007	(8%) 1,066,664
Surplus	$4,320,055	$861,081	$464,299

Adding to Western Union's figures the gain in surplus to Dec. 31, we may figure comparative share earnings and the returns to an investor as follows:

	Am. Tel.	West. Un.	Com. Cable.
Price of stock	$165	$90	$160
Dividend to price, per cent.	4.54	5.55	5.00
Earned on par value	11.33	6.38	11.47
Earned on price	6.86	7.09	7.16

Although the return on the price of the shares of the Telephone Company is shown to be lower, this is not at all unfavorable to that stock. The securities of all companies with good credit sell higher in proportion to earnings. There is, furthermore, a probability that in the next five years, with the expansion of the telephone business, rights of at least 10 per cent. to 15 per cent. will accrue yearly, so that at the end of that period an investor will be receiving 7½ per cent. dividends on stock whose net cost might have been reduced by subscription rights to about par. It will be observed that the calculations do not make any allowance for "independent telephone" inroads, but the Western Union also might be adversely viewed, or the Postal, as to the possible effects of competition.

American Electrochemical Society.

The programme of the American Electrochemical Society for its second general meeting has been completed, and includes no less than 20 papers, with several more to be announced later. The meeting will be held at Niagara Falls, September 15-18, with headquarters at the International Hotel. The mornings will be devoted to the reading and discussion of papers, and the afternoons and evenings to professional visits and social occasions. Following is a list of the papers to be read:

"Note on Testing Carbon Electrodes," by Francis A. J. Fitzgerald, Niagara Falls, N. Y.

"Efficiency of Electric Furnace Operations," by Prof. W. J. Richards, Ph. D., Leigh University, Bethlehem, Pa.

"Additional Notes on Lead Reduction," by P. G. Salom, Philadelphia, Pa.

"Cathodic Reduction," by Alfred T. Weightman, Niagara Falls, N. Y.

"Differences of Potential between Metallic Cadmium and Solutions of Cadmium Iodide in Various Solvents," by Prof. Louis Kahlenberg, Ph. D., University of Wisconsin, Madison, Wis.

"The Fusion of Quartz in the Electric Furnace," by Prof. R. S. Hutton, Owens College, Manchester, England.

"Developments in Electrometallurgy of Iron and Steel," by Marcus Ruthenberg, Philadelphia, Pa.

"Theory and Practice of Continuous Flow Calorimetry," by Prof. H. T. Barnes, Ph. D., McGill University, Montreal, Canada.

"An Apparent Electrochemical Paradox," by Carl Hering, Philadelphia, Pa.

"Some Phenomena of Electrolytic Conduction," by C. J. Reed, Philadelphia, Pa.

"The Nickel Concentration Cell," by Prof. Henry S. Carhart, LL. D., University of Michigan, Ann Arbor, Mich.

"Electrochemistry at the World's Fair, St. Louis," by Prof. W. E. Goldsborough, Lafayette, Ind.

"The Electronic Hypothesis and Its Applications," by Arvid Reuterdahl, Providence, R. I.

"Electrochemieal Polarization," by Prof. John Langley, Ph. D., Cleveland, Ohio.

"Storage Battery Invention," by Hugh Rodman, Philadelphia, Pa.

"The Electrolytic Dissolution of Soluble Metallic Anodes," by Woolsey McA. Johnson, New Brighton, S. I., N. Y.

"On the Electrolysis of Sodium Nitrate and the Composition of the Developed Gases," by C. W. Volney, Ph. D., Keyport, N. J.

"Pumps and other Accessories in Electrolytic Plants," by D. H. Browne, Cleveland, Ohio.

The titles of papers by Prof. G. B. Frankforter, of the University of Minnesota, and Mr. Titus Ulke, of Sault Ste Marie, will be announced later.

Transposition of High-Potential Alternating-Current Lines.

One of the "Question Box" queries considered at the Cincinnati Electric Light Convention was concerning the best practice in the concatenation of the conductor of high-potential transmissioon lines. The Portland (Me.) Light and Power Company reported that it is operating two 10,000-volt, three-phase, 60-cycle alternating-current lines, one of which is ten and the other thirteen miles long. No transpositions have been placed in either of the lines, and no difficulty has been experienced on account of induction. Mr. J. W. Cortwright, of the Public Works Company, Bangor, Me., said that the 6,600-volt alternating transmission of his company, about five miles in length, is not transposed at all. It is run on the old single-petticoat glasses formerly used for a direct-current arc circuit, and shows next to no leakage in wet weather, and no line characteristic of a troublesome nature. Mr. E. Grissinger, of the Buffalo General Electric Company, considered that lines of this length mentioned do not involve considerations other than the mechanical features. In a 15-mile line of moderate power, three transpositions should give all the necessary flexibility. If such a line were made up of more than one circuit, then the transpositions should have some regard for the amount of power transmitted in each circuit, the voltage, phase and frequency, in order to compensate inductive effects between circuits

Dr. F. A. C. Perrine went into the subject of transpostions at consdierable length. The transposition of any line, whether long or short, high or low potential, he said is for the purpose of overcoming the evil effects of mutual electromagnetic induction. This mutual induction may result in interference with neighboring lines of the same class and character, or may result in interference with neighboring lines of an entirely different class. For example, many parallel lines running out from a station may act inductively on each other, the lines carrying low currents disturbing the potential on lines carrying low currents and *vice versa*; or the lines from any station running parallel to telegraph or telephone lines may, by inducing current upon these neighboring lines, interfere with the apparatus connected with them. This mutual induction may be due to the electrostatic effect or the electromagnetic effect.

Dr. Perrine said that so far as he is aware, no satisfactory cure has been effected of the electrostatic interference. The electromagnetic interference may be overcome by proper transpositions, and whether transpositions shall be placed in lines from one to fifteen miles in length depends almost entirely upon the quantity of current these lines are carrying and on the proximity of other lines and their character. Telephone lines run for one mile or more parallel to power lines are almost invariably seriously affected, and for these lines transpositions should undoubtedly be introduced either in the telephone lines themselves or in the adjoining power lines. The telegraph not being as sensitive as telephone apparatus, is not so readily affected, and the cases are rare where the interference is serious where the lines are parallel for distances less than four or five miles; indeed, the problem of properly doing away with mutual induction between power lines and grounded telegraph lines is one that has to be handled most carefully, since the ordinary method of transposition is generally unavailable to remedy the difficulty. Power lines carrying less than 100 amperes do not ordinarily interfere with each other to a serious extent where they are run parallel for less than two or three miles, but for greater distances and greater currents they undoubtedly interfere and should be transposed. In one case where many lines carrying large currents were run out of the station for distribution to a city and were parallel in some cases for not over 1,000 feet, the interference between the different power lines was so serious that pressure wires run back to the station gave no indication of the pressure at the terminals, since both the power lines themselves and the pressure wires were seriously affected by neighboring currents.

Dr. Perrine pointed out that transpositions carelessly done without due regard to what a transposition is to effect are of comparatively little value. He cited a line where the telephone circuit was transposed every eighth pole and where not only was the telephone useless, but the bells burned out, although the power line was carrying only about 20 amperes. This trouble was remedied altogether by taking out these transpositions and putting in transpositions about one every 80 poles, but properly located with reference to the transpositions of the power line, which had not previously been taken into account. In order to lay out the transpositions of any line it is necessary to follow in direction and amount the field of force surrounding the line itself. Single-phase lines are transposed simply as telephone lines by crossing them, since any two sections of equal length between which there is a cross have equal fields of force acting in opposite directions, and consequently neutralize each other. A barrelling of a three-phase line rotates the field of force one-third of a revolution, and in consequence, it is necessary to rotate the line twice before the individual equal sections neutralize each other, and in this case no two of the three equal sections between which there are transpositions neutralize, though the three are neutral when taken together in reference to any parallel line. The four-wire, two-phase line is only neutralized when there are three barrelings and four sections of equal length; the three barrels divide the line into four sections of equal magnetic strength. These four sections neutralize each other in pairs, but no two neighboring sections neutralize. The first and third neutralize each other, but the first has no influence on the second or fourth, the second has no influence on the first or third, and so on.

Dr. Perrine said that it is stated that the barrelling of a line is necessary for neutralizing the effect of the earth upon that line itself, but so far as he has been able to observe no such effect is to be found, two and three-phase lines without any transpositions working as well as those which have been transposed or barrelled, provided the three-phase wires are located at the corners of an equilateral triangle and the wires of each phase of a two-phase line at the diagonally opposite corners of a square. In transposing any line with reference to any other line the transposition should be introduced in sections where the current and consequently the magnetic field is constant. If this question of the constancy of the magnetic field and the effect of its direction already described be taken into account, all interference to or from neighboring lines is readily overcome. The question whether the lines carry high or low potential is not important with reference to transpositions, since the effect of high potential is to produce electrostatic induction, and this effect is not readily overcome by transpositions.

Mr. P. M. Lincoln, of Niagara Falls, said that his experience has pointed to the fact that most of the trouble on high-tension lines is due to static and not dynamic induction. He has been told by others who have run high-tension lines that as long as they could keep the telephone and telegraph lines insulated from the ground, and overcome the static induction, they had no trouble from dynamic induction, although there is no transposition on telegraph and telephone lines.

Mr. P. A. Bertrand, of Peoria, Ill., said that last summer his company changed from 1,000 to 2,000 volts. While that is not a very high tension compared to the system which Mr. Lincoln represented, it brings out the point. The primaries, he said, were divided by two right through. The effect on the city telephone lines and police alarm lines was not to decrease the induction on their lines, but rather to increase it, which would point to the fact that it is static rather than dynamic effects which cause the trouble.

Telegraphy in Alaska.

Gen. A. W. Greely, Chief Signal Officer of the Army, who has just returned from Alaska, reports that before the end of the year Alaska will be connected with the United States by wire. In two weeks, he says, many hundred miles of telegraphic communication will have been established in that territory between the coast towns and those remote in the interior. Gen. Greely has been inspecting the operations in regard to telegraph lines. "This," he said, "will for the first time make it possible for intercommunication to be had at a small expense between those portions of the territory where previously correspondence could be had only by mail, and where letters and answers could not be exchanged more than twice or thrice during the year. Valdez, Alaska, will soon be in telegraphic communication with the outside world.

"That line runs from Dawson through Egbert, as a military wire, and is about 450 miles long. There are now in operation in the territory about 800 miles of wire in the central and lower Yukon Valley. They will be connected with the Valdez system, which will bring the lower Yukon, St. Michaels and Nome within daily reach of the rest of the world." The main trouble up in Alaska has consisted in the regular maintenance of submarine lines, which so far have experienced a series of disasters and interruptions.

Electrical Classification of Exhibits, St. Louis Fair.

Following is the official classification of electrical exhibits at the St. Louis World's Fair, which forms Department F of the general classification:

GROUP 67.—MACHINES FOR GENERATING AND USING ELECTRICITY.

Class 428.—Apparatus for generating electricity. Dynamos producing direct, simple alternating or polyphase currents.
Class 429.—Motors for direct or alternating currents.
Class 430.—Modification of currents. Motor-generators. Transformers.
Class 431.—Application to transportation. Electric locomotives, electric railway motors. Methods of control of cars and trains.
Class 432.—Application to mechanical purposes. Elevators, winches, cranes, capstans, transfer tables, traveling cranes, printing presses and machine tools.
Class 433.—Appliances and methods for the distribution of electric energy; conduits, cables, wires, switches, insulators, lightning arresters, circuit breakers, complete switchboards.

GROUP 68.—ELECTROCHEMISTRY.

Class 434.—Primary batteries. Storage batteries.
Class 435.—Electrolytic appliances and processes. Reduction of ores, electroplating, electrotyping.
Class 436.—Electrothermic appliances and processes. Production and refining of metals or alloys.
Class 437.—Application to industrial chemistry; bleaching, disinfection of sewerage water, manufacture of soda, chlorine, chlorate of potash, etc.

GROUP 69.—ELECTRIC LIGHTING.

Class 438.—Use of continuous or alternating currents. Arc lamps, regulators, carbons for lamps, incandescent lamps, other forms of lamps.
Class 439.—Complete installation. Factories, dwelling houses, public buildings and central stations.
Class 440.—Application to lighthouses, navigation, military service and public works.
Class 441.—Photometry. Apparatus for determining the intensity, the distribution and illuminating power of light.
Class 442.—Electric appliances. Apparatus for safety and regulation. Conduits, junction boxes, switches, cabinets, cut-outs, fixtures, chandeliers, etc.

GROUP 70.—TELEGRAPHY AND TELEPHONY.

Class 443.—Telegraph instruments, transmitters and receivers, recording apparatus, multiplex apparatus, synchronous apparatus, wireless apparatus.
Class 444.—Transmission of speech. Appliances and methods. Instruments, switchboards and complete exchanges.
Class 445.—Telegraph and telephone wires and cables. Overhead, subterranean and submarine, construction, materials and appliances.

GROUP 71.—VARIOUS APPLICATIONS OF ELECTRICITY.

Class 446.—Scientific apparatus. Laboratory standards. Indicators and recording apparatus for natural phenomena.
Class 447.—Electricity as applied in therapeutics, surgery and dentistry.
Class 448.—Electric signalling. Application of electricity to railways, mines, public works and buildings. Clocks, annunciators, chronographs, alarms.
Class 449.—Methods of measurement. Instruments; indicating, recording and integrating.
Class 450.—Apparatus for heating by electricity. Cooking apparatus. High temperature electric ovens. Electric welding.
Class 451.—Progress and development in electrical science and invention. Historic and statistical exhibits. Instruments, machines, models, drawings and publications.

Electroplated Lace.

BY CLINTON PAUL TOWNSEND.

In depositing metal electrolytically upon a non-conducting base it is, of course, essential that a conductive surface be afforded, and this is in general accomplished by the chemical precipitation of a thin layer of silver or other metal, or by the mechanical application of graphite or metal powders, often with the aid of an adhesive binding medium. Such coatings, and especially the highly perfect ones formed by the chemical precipitation of silver, are of a high degree of tenuity, and, therefore, of high electrical resistance, from which it follows that even with the low density currents used for electroplating the deposit cannot take place evenly over any extended surface. The important point, therefore, in securing a perfect cathode connection to work of this character is the number of the contacts.

Mr. John A. Daly, of Washington, D. C., offers a simple arrangement for electroplating lace, consisting of an open-meshed basket of copper wire upon which the lace, suitably prepared with a conductive coating, is stretched. Fine copper wire is then wound in coils around the basket and over the lace in such manner as to secure the fabric and to provide a number of contacts which must be greater in proportion as the mesh of the lace is more open. Deposition is said to proceed evenly over the entire surface, and it is claimed that the simplicity of the manipulation effects a saving of 90 per cent. of the time usually required for wiring.

The deposition should proceed under these conditions for a few moments only, the object being merely to stiffen the fabric by a preliminary deposit in order that it may be hung in the bath from the usual supports to receive the final and heavier coating.

CURRENT NEWS AND NOTES.

PATENTS ON MANUFACTURES.—The U. S. Census Office has issued a bulletin on the relation of patents of manufactures. It states that New York State, though third in population and patent rank for the first decade, has since been first in both as well as in manufacture.

"THE TELEGRAPH KAISER."—Apropos of Emperor William's telegram to the Prince Regent of Bavaria, resenting strongly the refusal of the Bavarian Diet to vote certain art funds, the *Wiener Allgemeine Zeitung* publishes an article headed, "The Telegraph Kaiser." The paper says that the Emperor's advisers ought to keep him as far as possible from facilities for telegraphing, and provide lightning conductors, which would prevent the flashes so easily drawn from the imperial mind by every passing event from causing panic and confusion in public life. That, says the *Wiener Allgemeine Zeitung*, would be of advantage not only to Germany, but to the Emperor himself, who betakes himself to the wire whenever he is gratified or irritated, amused or saddened. The dispatch is sent off in the twinkling of an eye, but the task of remedying the consequent evil is extremely slow. The paper remarks that the famous telegram to Mr. Kruger after the Jameson Raid was followed by the investment of Lord Roberts with the Order of the Black Eagle.

GIRL MESSENGERS.—A special telegram from Chicago, of August 22, says: Girl messenger boys in office buildings were an innovation which Chicago experienced to-day. They took the place of the striking messenger boys of the Illinois District Telegraph Company. The girls came in answer to the following advertisement: Wanted—100 young ladies for work within large buildings; salary $15 to $25 per month. Apply I. D. T. Office, 820 Western Union Building. Tenants in the skyscrapers were surprised when in answer to their call for a telegraph boy they were confronted with stately-looking "young ladies," who announced themselves as messengers who had responded to the call. The striking messenger boys were startled, too, when they learned that girls had been secured to take their places, and declared their determination to make love to the non-unionists and thereby induce them to stop work. Attempts to enter the buildings, however, were frustrated, and as the girls did not carry messages outside, the boys failed in their plans, being forced to look on at a distance.

RELIABILITY AUTOMOBILE CONTEST.—The Automobile Club of America has announced conditions for a 500-mile automobile reliability contest to Boston and return, with a view of affording an opportunity for the various types of motor vehicles to demonstrate their reliability under circumstances as closely as possible simulating general touring conditions in the United States. The contest will be one of seven days. The vehicles will start their journey on Oct. 9, the first day's run being to New Haven, and the competition will end on Oct. 15. Speed in excess of the legal limit will be absolutely prohibited under pain of disqualification. It is reported that vehicles equipped with the Edison storage battery will be put into this test.

ROTARY CONVERTER "PUMPING."—Two patents, issued August 19, to Alexander Churchward, describe a means for overcoming the difficulties encountered in operating synchronous alternating-current motors when the generator fluctuates in speed in different parts of a revolution, the effect of which is to produce "pumping" at the motor. The method consists in applying to the shaft of the motor, or on a shaft driven by it, a flywheel connected to the shaft through a yielding connection in the nature of a friction brake. The effect of this flywheel is as follows: If the generator speed suddenly increases, the armature tends to correspondingly accelerate its speed; but the flywheel lags behind, thereby putting a slight load on the motor. When the generator slows down the motor-armature tends to run slower, while the flywheel, tending to run at a uniform speed, catches up with the motor-shaft and forces it ahead or resists its tendency to slow down, thereby again putting a slight load on the motor. The load in either case serves to steady the armature and prevent pumping. One of the patents describes details of the flywheel flexible connection.

THE NAVAL MANŒUVRES.—Two squadrons of U. S. men-of-war have been engaged in manœuvres the past week off the New England coast. Admiral Higginson, commander of the victorious defensive fleet, says: "To me the one great lesson of the search problem which we worked to a finish to-day is the absolute need of wireless telegraph service on the ships in our navy. Do you know we are three years behind the times in the adoption of the wireless system aboard our ships, and its value to me during the last four days would have been incalculable? I could have spoken my ships at sea night or day at any moment by wireless telegraphy; whereas during the last four days, while all were in touch with me, they have been far beyond signalling distance, and, as it were, beyond my reach altogether. I am convinced of the value of manœuvres of this kind. It has been excellent training and as near an approach to conditions of actual warfare as could be devised for manœuvres of this measure. The schooling of the work of the last four days, while a little different from the actual work of routine, has been held under conditions which have made them of extraordinary value."

ALTERNATING CONSTANT-CURRENT CIRCUITS.—Two patents relating to alternating, constant-current, arc-light circuits were issued, August 19, one to John F. Kelly, and the other to Walter S. Moody. The latter relates to a means for avoiding injurious effects arising from grounds on a circuit, including a Thomson constant-current transformer. This is accomplished by causing the current to pass first through one portion of the transformer or reactive winding, then through the lamp circuit, and finally through the other portion of the winding. To still further guard against bad effects from grounding, the neutral point of the supply circuit is permanently grounded, either at the generator or through the middle point of a transformer primary. The above-mentioned method of winding the constant-current transformer also admits of the attachment of a simple device for indicating when a ground comes on the circuit. The Kelly patent describes an arrangement whereby an alternating constant-current circuit may be maintained without the accompaniment of low power factor affecting the supply circuit, as when a reactive transformer is employed. The system consists of a synchronous motor driving an alternating-current generator, so designed as to maintain automatically a constant current in a circuit of varying impedance, such as a series arc-lamp circuit. Though the power factor of the lamp circuit will be low at light loads, the main supply circuit will not be affected, the motor operating just as it would with any corresponding load of a mechanical nature.

LETTER TO THE EDITORS.

The Second Law of Thermodynamics.

To the Editors of Electrical World and Engineer:

Sirs.—Your editorial in the issue of August 2, 1902, on "The Alleged Fallacy of the Second Law of Thermodynamics" was very interesting reading. On the whole I thoroughly agree with the position there taken, or possibly with the tone of the position. I think your statement of the question is very pointed and just.

The law, as you say, states that a heat motor must necessarily work between different temperatures, or rather between a source of heat and a refrigerator. At the risk of speaking heresy, I would like to say that while, as regards the law itself, I agree with it from a practical standpoint—that is, what we are able now to do—still I cannot say that I do from a theoretical one, or what may yet be done.

Sadi Carnot, I believe, proposed that it might be possible to run a heat engine from the intrinsic heat in sea water. Several years ago I noticed the fact that a reversed heat engine, or in common parlance, a refrigerating machine, operated at an efficiency of 300 to 500 per cent. That is to say, that a ton of refrigeration accomplished represented, in heat units, three to five times the equivalent energy in foot-lbs. required to do the work. I investigated theoretically the possibility of running a heat engine between sea water or air as the source, and a refrigerator worked by its own power, but I finally concluded that when the efficiencies of the two machines were multiplied up together, the result would in all cases equal unity, thus:

$$\frac{t_2 - t_1}{t_2} \times \frac{t_2}{t_2 - t_1} = 1.00.$$

The first factor is the theoretical limiting efficiency of the heat engine, the second is that of the inverted heat engine or refrigerator. This is to say that the large efficiency of the refrigerator, in any case *I could imagine,* would be just equal to the inefficiency of the heat engine, and that, therefore, no extra power could be produced. So from a practical standpoint, the second law has some ground for existence. But does it from a theoretical?

J. Clerk Maxwell showed if a roomful of air were divided by a partition having frictionless doors, at each of which was posted an intelligent being devoid of energy, with instructions to manipulate the door at the proper times to allow all the fast moving air particles to go to one side of the partition, and all the slow to the other, the resulting condition would be that on one side of the partition the air particles would be moving very rapidly, and on the other side, very slowly. One room would be hot and the other would be cold; in other words, a source and refrigerator produced from a uniform medium without the expenditure of energy. Of course, a heat engine could be run from this, so that a process can be imagined in which a heat engine can be run from a uniform medium.

Another instance in which Maxwell's daemons of the imagination have been pressed into service is afforded by the proposition of Lord Kelvin, to place a lot of these little fellows around a flexible bag of air, with instructions to push in the wall of the bag when no air particle was striking it, and to hold it in place while a particle was striking it. The motion and the force being applied at different tmes, no energy would be consumed, though the bag would finally contain compressed air. This is a direct and very pretty proof that compressed air has no more energy than the same mass of air not compressed.

It may be novel to some of your readers to consider that some of the cars operating in New York City are run by heat engines, which do not work between a source and a refrigerator. I refer to the compressed-air cars.

An air motor working without a reheater of any kind is essentially a heat motor and draws its power from the heat in, and not from the compression of the air which works it. The compression of the air is only a mechanical daemon or vehicle through which the extraction of the heat in the air and its transformation into work is made possible. Even supposing that it could not be imagined, as above, that air could be compressed without energy, yet the knowledge that the compression of air does not represent energy would be a direct proof that a heat engine, which an air motor is, can be operated (practically, notice) in a uniform heat medium.

Now truth comes to us not only through scientific processes of reasoning, but also through the imagination. It is by this, I think, that we realize the infinity of time and space. In this case, I believe that the imagination is distinctly at variance with the scientists. Yet this is no reason for doubting the imagination. Her truth is true. Its qualities are not different from any other truth, though arrived at by another avenue. I believe that here science has made the mistake of taking a limited premise instead of a universal one.

In the particular case which I investigated, the law was true; but in the subsequent cases to which we have given our attention, it was not true.

Now, I would not like to say that I think it possible to produce a practical heat motor along the lines which we have traced; still I think it is not a good scheme to set up a barrier because in our *practice* (perhaps the result of our peculiar education and experience) such a barrier exists, and this is particularly true when our imagination finds none. The older I grow, the more I learn to place only a tentative trust in the statements of science, and I believe that modern thought is doing the same thing. We have had a very recent experience with the atomic theory, which for nearly two thousand years has been accepted as axiomatic, and yet has broken down on the addition of only "the last straw."

It is well to quelch quasi-scientists, for they do a great deal of harm. And yet some day the race must obtain a new source of power or our giant civilization must fall to the dust. The road by which our children's children's children will travel to that sure goal may very possibly be in the face of the science of to-day, which may be forgotten then—but a poor thing, which has served its use well, and has gone.

MONTREAL, CANADA. IRVING A. TAYLOR.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Heyland Motor.—HEYLAND.—A reply to Latour's last communication, noticed in the Digest last week. The 27-hp Latour motor has 4 poles and 159 segments, *i. e.*, 40 segments per pole. A 45-hp Heyland motor has 8 poles and 36 segments, *i. e.*, 4.5 segments per pole. The commutator of the Heyland motor has "per hp" a ten times smaller surface than the commutator of the Latour motor; the former has the dimensions of an ordinary slip-ring, and is only an accessory. The compounded Heyland motor has one commutator; the compounded Latour motor has two commutators. The editors state that this controversy is now closed in that journal.—*Elek. Zeit.*, July 17.

Heyland Motor.—ZIEGENBERG.—A brief communication stating that a patent of Hasslacher seems to anticipate some special features of the Heyland motor, so that the Heyland motor might be called an application of the device of Hasslacher to the old Georges motor.—*Elek. Zeit.*, July 17.

Determining the Efficiency of an Electric Motor.—JOBST.—A brief illustrated article on the most suitable arrangement for an exact braking method for determining the efficiency of an electric motor. For counting the revolutions he uses a speed counter of Siemens & Halske, which is based upon the principle that the voltage of a dynamo depends upon its speed, the poles of the dynamo being highly saturated by means of a special source of current, so that the armature reactance and oscillations of the exciting current do not influence the constancy of the magnetic field; the voltage is then proportional to the speed; for measuring it a millivoltmeter is used. For braking, an eddy current brake is most suitable, together with a spring balance. All the instruments are mounted on a board, and instantaneous readings are obtained by photographic means.—*Elek. Zeit.*, July 17.

Definition of Armature.—ZIEGENBERG.—A communication in which he proposes to define as the armature (anker) of an electric machine as that part in which by the relative motion with respect to a magnetic field, an interchange of mechanical and electrical energy takes place, characterized by the occurrence of a higher e. m. f. than is due to the effective resistance.—*Elek. Zeit.*, July 3.

REFERENCES.

Commutatorless Continuous-Current Motor.—BRUGER.—Such a motor for meters is described in the abstract on motor meters, under instruments.

Sparkless Commutation.—KEHSE.—A communication referring to a special point in a recent paper of Niethammer. He remarks that sparkless commutation can be accomplished by two different means: First by the carbon transition resistance, second by the e. m. f. induced in the short-circuited coil from the external field. He gives some mathematical formulas.—*Elek. Zeit.*, July 3.

Theory of Commutation.—PICHELMAYER.—A supplement to a former article which he had published on this subject.—*Elek. Zeit.*, July 17.

Armature Winding.—KUEBLER.—A brief article in which he describes a very simple tabular representation of continuous closed circuit windings.—*Elek. Zeit.*, July 17.

Armature Reaction.—BAUCH.—A very long illustrated paper, read at the recent meeting of the Association of German Electrical Engineers. He endeavors to give a complete theory of armature reaction and discusses the distortion of the field by the armature current, and the diminution or increase of the e. m. f. by means of the armature current.—*Elek. Zeit.*, July 10, 17.

Calculating the Characteristic Curves of the Induction Motor.—BERKITZ.—A brief critical note on Lindstroem's method noticed recently in the Digest.—*Elek. Zeit.*, July 17.

Preventing the No-Load Loss of Transformers.—ANKERSEN.—A rather long communication, in which he criticizes and corrects several statments in a recent article on switches for disconnecting transformers at a distance, recently noticed in the Digest.—*Elek. Zeit.*, July 17.

LIGHTS AND LIGHTING.

REFERENCE.

Mercury Vapor Lamp.—STOECKHARDT.—A brief communication, in which he suggests that a still better economy might be obtained if the whole lamp or tube be placed in another evacuated glass globe, as the conduction of heat would then decrease.—*Elek. Zeit.*, July 17.

TRACTION

Sutton and Howth Tramway.—An illustrated description of this newly opened electric line in the vicinity of Dublin. Steep gradients on a hill presented many difficulties in the construction of the line. These were finally overcome by the adoption of long S-shaped curves, which were arranged so as to reduce the rise to one in twenty. The equipment of the power plant consists of three vertical compound, non-condensing steam engines, direct connected to compound-wound generators of 125-kw capacity, at 550 volts, running at 350 r. p. m. Three brakes are provided for each car, namely, the ordinary hand-brake, an electric brake, and a Westinghouse air-brake, the latter being supplied with air at 75 lbs. pressure from storage reservoirs placed under the car seats; these are fed at the car shed by Westinghouse motor-driven condensers. A signal system has been established and consists of electric lamps placed in combined signal and telephone boxes along the route at each loop; the heat from the lamps circulates through the telephone compartments and thus keeps the instruments in good condition and free from moisture. At the summit, there is also a substation equipped with a battery of 255 Tudor cells of 200 amp.-hours capacity, with the necessary booster for charging it.—*St. R'y Jour.*, August 2, and *Int. Ed.*, August.

Automatic Signal for Block Systems and Car Spacing.—An article in which it is said that the importance of a block system on steam roads is little greater than the importance of having such systems on the high-speed electric roads now in operation. With the device described there is always a light burning at each turnout, in-

candescent lamps being used. The signal is operated by the trolley wheel making a contact between the trolley wire and the independent circuit. The operation of the system is such that if a white light signal is set there will be a red light on the far turnout in front and a green light on the near turnout; thus the motorman seeing a green light knows that the signal is set at danger at the next turnout. When a car is passing over a section both lights will appear white and a car can now enter from either end with a clear track. With the double-track system a similar combination of the lights indicates the position of the car ahead of the motorman; thus, a white light shows that the car can proceed at full speed, a green light shows that a car is one block ahead, and a red light means that the car is within one block of its leader.—*St. R'y Jour.*, August 2, and *Int. Ed.*, August.

Trolley Omnibus Line Between Nice and Monte Carlo.—An illustrated description of the auto-trolley system of omnibus which it is proposed to introduce upon the Corniche road extending through the mountain district between Nice and upper Monte Carlo. Similar equipments have been installed in several places in France and Germany, as has been noticed in the Digest. The buses used on the Corniche line will be a modification of those that are now employed on the French and German lines. They will be equipped with the Lombard-Gerin type of current-controller, which was shown at the Paris Exposition, as has been noticed before. There is a small three-phase motor, suspended between two conducting trolley wires. The motor is hung on a frame which supports at the same time two trolley wheels. It is of fixed armature type, and its pole pieces impart a rotary movement through fibre friction wheels to the two trolleys which are fixed on the same axle and run over the trolley wires. An even friction adjustment is obtained by the regulation of special suspension springs. A flexible cable leads the current from the main line to the car, and the three-phase current from the car to the little trolley motor which is fed from the motors which run the vehicle. As the speed of a three-phase motor is synchronous with the current feeding it, it is evident that the trolley motor runs automatically at a speed proportional to that of the motor on the vehicle. In this special case the proportion of gearing has been calculated so as to allow the trolley motor a slight lead over the car itself, in order to have the flexible cable at the proper tension. A small electromagnetic brake blocks the trolley motor on the wire whenever the vehicle is obliged to stop on steep grades. The trolley motor with its accessories weighs about 40 lbs. It is proposed to take current for the operation of the system from the Mediterranean Power Company, which has a large central station at Nice and others at convenient points. Three sub-stations will be erected along the line, one at each end and one midway, in which will be installed rotary converters for reducing the three-phase current from 10,000 volts to 500 or 550 volts, at which it will be delivered to the motors.—*St. R'y Jour.*, August 2, and *Internat. Ed.*, August.

Through Traffic on Tramways for Passengers and Goods.—Waller.—An abstract of a paper presented to the Liverpool Chamber of Commerce. The author proposes to link together several systems, and persuades the local authorities to grant "through" running facilities. He describes the advantages which would result, as a much larger traffic could be dealt with. The parcel traffic would probably be considerable and would be carried in the day time, either by trailer cars or by special independent vans. The cost of conveyance of both goods and parcels would undoubtedly compare most favorably with that entailed in the present method of railway carrying, and the profits gained thereby would go a long way towards making electric tramways still greater financial successes than they are at the present day.—Lond. *Elec.*, July 25.

REFERENCES.

Traction Stations.—Eisig.—A long article, in which he discusses some special features of traction stations, and the different subheadings being boilers, engines, gas motors, turbines, the choice of the generating sets, storage batteries, substations, automatic circuit breakers.—*Elek. Zeit.*, July 3, 10.

Calculating the Feeders for Tramway Installations.—Lieber-Wikander.—Two communications giving critical notes on the recent paper of Lengel.—*Elek. Zeit.*, June 19, July 3.

Wear and Maintenance of Tramways.—Wike.—An illustrated paper, read before the Association of Municipal and County Engineering. He discusses the wear of rails, the rail joints, points and crossings, and paving.—Lond. *Elec. Eng.*, July 25.

Street Railway Investments and Earnings.—Adams.—A statistical article on the investments and earnings of the street railways in Massachusetts between 1888 and 1901.—*St. R'y Rev.*, July 20.

Electrolysis of Gas Mains by Tramway Return Currents.—Swinburne.—The first part of a reprint in full of his recent paper, an abstract of which was noticed in the Digest.—Lond. *Elec.*, August 8.

International Permanent Tramway Union.—A full account of the proceedings at the recent London convention of this association, with reprints of the papers. A general account of this meeting has already been given in the Electrical World and Engineer.—*St. R'y Jour.*, August 2, 9, 16, and *Internat. Ed.*, August.

Wires, Wiring and Conduits.

Self-Induction and Capacity in Transmission Lines.—Baillie.—The conclusion of his article. He discusses the effect of capacity. While self-induction affects the drop of pressure, but not the power wasted in the line, capacity has the opposite effect. Capacity has practically no effect on the drop in pressure, but with a power factor less than unity it diminishes the power lost in the line, provided that it be not so large as to produce a large advance of phase. With a low power factor the saving due to capacity will in general be greater than any loss due to dielectric hysteresis or charging current, when the load factor is not very low. He first gives formulas for single-phase and three-phase overhead lines. He then discusses single-phase concentric cables, and gives various formulas and diagrams. In one of them the saving in per cent. of power loss, due to resistance, is given as a function of the ratio of the charging to the effective current, for various power factors. The saving due to capacity reaches a maximum for a certain ratio, depending on the power factor. For a power factor of 0.9, the maximum is reached when the charging current is three-quarters of the effective. With the charging currents only one-fifth of the effective current, the saving is not inconsiderable; with a power factor of 0.7 it is 9.3 per cent. A 9.3 per cent. saving, due to capacity, means that for a given loss the cable may have a sectional area about 9 per cent. less if the capacity be taken into account. For a given cable end pressure the effect of capacity increases as the square of the length of the cable. For long transmissions the saving is very large. He then gives formulas for three-phase cables. In conclusion the author states that so great is the saving which can be effected in a supply at low power factor that, in spite of previous failures, it is not improbable that condensers will eventually come into use in cases where the line capacity is insufficient. An instance where this has already been done is on the Tivoli to Rome, 10,000-volt transmission, a condenser made by Prof. Lombardi having been connected across the line. With a condenser at the far end of the line a greater saving is possible than with distributed capacity, and less capacity is required to give the same saving. At a power factor of 0.7, the section of copper could be halved by the use of a condenser to produce balance at full load; but then, unless the load factor were very high, it would have to be cut out below half-load. The method of neutralizing lagging currents by over-excited synchronous motors is complex in comparison, but is free from the dangers attendant on breaking a circuit having capacity. "After all, these may prove so serious as to counterbalance all the virtues of capacity."—Lond. *Elec.*, August 8.

Three-Wire Distribution.—An editorial discussion of several problems arising in connection with the three-wire, direct-current system, with 400 to 500 volts between the outers. The degree of interconnection of the network is first discussed, that is, whether the distributing cables should be connected up in a closed network fed at certain feeding points or whether the district should be divided up into sections, each with its own distributing network and with its own feeder or feeders; it depends upon local conditions. The former method has the advantage of better pressure regulation, the latter the advantage that the effect of a fault is more local, and that the fault itself is easier to detect and locate. It is recommended to earth the middle wire at the station only and to avoid fuses on the middle wire.—Lond. *Elec.*, August 8.

REFERENCE.

Sag of Copper Lines.—Krohne.—An article on the question of how much sag should be used in bare soft copper wire lines. He gives various tables and diagrams. *Elek. Zeit.*, July 3.

Electro-Physics and Magnetism.

Conductivity and Atomic Heat.—Streintz.—A paper in which he shows the existence of some interesting relations. Clausius believed

that the resistance of metals was proportional to their absolute temperatures, and that, therefore, the coefficient of thermal increase of resistance was the same as that of the expansion of gases, viz., 1/273; more recent measurements made with carefully purified metals have shown that the rule does not hold good, as palladium, according to Demar and Fleming, has a smaller coefficient, and all other substances a large coefficient. The present author shows, however, that if the metals are arranged in groups of lower and higher atomic weights, a general rule may be formulated, according to which the coefficient increases in each group with the atomic weight. A more important relation is that between resistance and atomic heat. As the thermal coefficient of the atomic heat falls, so the thermal coefficient of the resistance rises. In all metals whose atomic weight is above 100, the thermal coefficient of the resistance is the greater the greater the atomic volume, and the smaller the displacement of an oscillating atom in comparison with the distance from the neighboring atoms.—*Ann. d. Phys.*, No. 8; abstracted in Lond. *Elec.*, July 25.

Radioactivity Produced by Light.—LE BON.—An account of experiments in which he studied the effects of light of different wavelengths upon all kinds of material bodies. He found that practically every kind of matter may be made to emit Becquerel rays by the action of light alone. If a body is exposed to sunlight, or, still better, to ultraviolet light, it gives off a form of radiation which is capable of discharging a positively charged electroscope. Amalgamated tin, copper or zinc show the strongest effect, black paper and lamp-black are almost as good. Living matter shows least of all.—*Comptes Rendus*, July 7; abstracted in Lond. *Elec.*, July 25.

Tesla Currents from Induction Coils.—MOEHLMANN.—A paper in which he maintains that the difference between Tesla currents and those furnished by an induction coil is only one of frequency and of tension. With an induction coil giving sparks of 50 cm., fed by an alternating-current dynamo giving 350 reversals per second, he obtained all the characteristic phenomena described by Himstedt, viz., that a disc placed opposite a point connected with the source was positively charged at short distances, and negatively at greater distances. Between the two cases there was a point at which the disc was not charged at all. The position of the point of reversal was found to be only dependent upon the potential of the source, and not upon the frequency. The higher the potential, the further do the positive ions penetrate, and the greater; therefore the distance of the neutral position. It appears that smooth, rounded surfaces give off negative ions by preference, and rough or pointed surfaces, positive ions. This explains why positive ions are best obtained by fusing a platinum wire into a glass tube and filing the projecting point down to the level of the glass. The sides of the wire, which are smooth, are thus prevented from sending out negative ions, and the point alone remains in action.—*Ann. d. Phys.*, No. 8; abstracted in Lond. *Elec.*, July 25.

Optical Effect of a Current in a Metal.—BEVAN.—A discussion of the question whether the optical constants—such as the reflective power of a metallic mirror—are altered on conducting a current through it, and whether such alteration persists as long as the current lasts. He calculates the effect theoreticaly on the basis of Drude's theory. He finds that the effect of the current in the metal is to cause an alteration in the constants of the metal, but this aleration is too small for the effect to be measurable, taking one-hundredth of a wave-length as the minimum change of phase which can be detected.—*Proc. Cambridge Phil. Soc.*, May 5; abstracted in Lond. *Elec.*, July 25.

Hall Effect in Gases.—WILSON.—A paper describing experiments in which he demonstrates with great success the existence of a Hall effect in the positive column of a vacuum discharge. The condition theoretically necessary for the existence of a Hall effect is a difference between the velocities of the two kinds of ions, and this is known to exist between the fast negative and the slow positive ions of the vacuum discharge. He found that the Hall effect was independent of the current, but proportional to the intensity of the magnetic field. The arrangement of his apparatus is described and illustrated. His results show that the Hall effect varies along the tube very nearly as the electric intensity, but in the striated positive column the Hall effect falls to an almost zero value between the striæ, whereas the electric intensity only falls to a comparatively small extent. It appears, therefore, that the difference between the velocities of the negative and of the positive ions in the dark spaces between the striæ is very small. It is probable that when a molecule is ionized, a free electron or negative corpuscle is split off, which is of very small mass compared with the positive ion. The difference of the velocities is thus at first very large. After a short time, however, the negative electron probably becomes attached to a neutral molecule, so that the two ions are then at almost equal mass, and the difference between the velocities is very small. It seems, therefore, probable that electrons are formed largely in the striæ, and that by the time they get into the dark spaces the electrons have become attached again to molecules.—*Proc. Cambridge Phil. Soc.*, May 5; abstracted in Lond. *Elec.*, July 25.

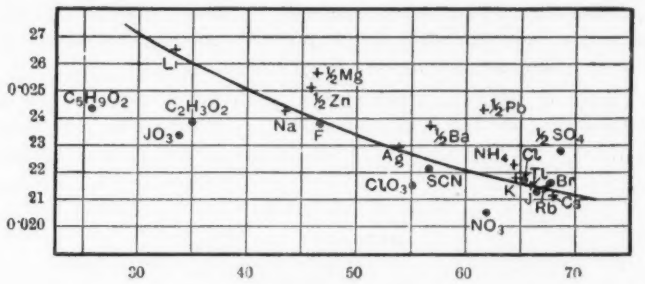
Electromagnetic Relations.—RIGHI.—A discussion of the experiments of Cremieu, and their bearing upon the four electromagnetic effects predicated from Maxwell's theory. The four effects are: First, the production of a magnetic field by a moving electric charge; second, the production of an electric impulsive force by a varying magnetic field; third, the production of an electric field by a moving magnetic pole, and, fourth, the production of a magnetic impulsive force by a varying electric field. Of these, Cremieu denies the existence of the first and second; the third and fourth have not yet been studied. The fourth offers the same difficulty as the first, inasmuch as the magnetometer must be protected from direct electrostatic action by a conducting shield. The author deals especially with the second effect, and gives reasons for regarding Cremieu's results as inconclusive. He describes his own experiments on the same subject, which are of extreme delicacy, but also hitherto inconclusive, owing to the many sources of error involved. In conclusion, he shows that Cremieu's negative results are not able to shake our confidence in the soundness of modern electromagnetic theory; but it would be very desirable that experiments be made along all the four lines indicated, so as to clear up the matter thoroughly.—*Phys. Zeit.*, July 1; abstracted in Lond. *Elec.*, July 25.

REFERENCE.

Phase Difference.—BENISCHKE.—A communication in which he makes some critical remarks on Orlich's recent article on the definition of phase difference.—*Elek. Zeit.*, July 10.

ELECTRO-CHEMISTRY AND BATTERIES.

Ionic Mobilities.—F. KOHLRAUSCH.—An account of an investigation, in which he has succeeded in discovering and confirming a new law with regard to the mobility and temperature coefficient of conductivity of monovalent ions. It appears that the temperature coefficient is simply a function of the mobility, quite apart from the chemical nature of the ion. The accompanying diagram shows



IONIC MOBILITIES.

the mobilities at 18 degrees as abscissas, and the corresponding temperature coefficient as ordinates. He further found the mobilities of the positive and the negative ion tend to become equal with increasing temperature.—*Sitzunzsber Berl. Akad.*, May 29; abstracted in Lond. *Elec.*, August 1.

Electro-Chemical Behavior of Sulphur.—KUESTER.—A German Bunsen Society paper on the causes of the peculiar periodic changes sometimes observed in electrolytic measurements. By electrolyzing polysulphide solutions, he observed that the voltmeter and ammeter, connected with the decomposing cell in the usual way, showed regular periodic vibrations. He found that these are due to a layer of sulphur on the anode, being periodically formed and destroyed. This layer acts like an insulator and increases the resistance of the cell, hence the periodic vibrations of current and e. m. f.—*Zeit. f. Elektrochemie*, July 24.

Behavior of Diaphragms During the Electrolysis of Aqueous Solutions.—HITTORF.—A German Bunsen Society paper, in which he corrects a mistake made by him 45 years ago in his determinations of

transport numbers. When for the determination of transport numbers diaphragms are used, endosmosis takes place. Through clay diaphragms the solution goes in unchanged composition, and there is no error in the determination of the transport number. But animal membranes behave differently, at least for most aqueous solutions; changes are caused in the anode and cathode part which are not due to the electrolytic transference of the ions; hence the determination of the transport numbers from the concentration changes which actually take place becomes wrong.—*Zeit. f. Elektrochemie,* July 24.

Behavior of Bromine Against High-Tension Discharges.—KELLNER.—A German Bunsen Society paper. He discovered several years ago that pure dry chlorine gas when high-tension electric currents are sent through it shows some properties which the ordinary chlorine gas does not possess. He has now made experiments with very carefully purified bromine in vessels of glass, free from lead, and found yellow crystals deposited on the walls of the vessel; he does not know what they are.—*Zeit. f. Elektrochemie,* July 24.

Sterilizing Water by Ozone.—H. J. VAN'T HOFF.—A German Bunsen Society paper on the Vosmaer-Lebret system of sterilizing water at a large scale by means of ozone. This system has been used commercially, first in Schiedam, later in Nieuwersluis, near Amsterdam. In Schiedam this system has been used for about six months, for eleven hours per day, without any interruption. An alternator gives alternating current at 110 volts and 100 periods. A transformer raises the voltage to 10,000, at which tension the current is supplied to the ozone apparatus; one pole of the same is earthed. The ozone is formed by means of dark discharge, without any solid dielectrics. Through the ozonizer the dried air is driven at a speed of about 40 liters per minute; a concentration of 3.5 to 5 mgr. of ozone per liter is obtained. For sterilization purposes a concentration of 3 to 3.5 mgr. has been found to be sufficient. The ozonized air is then pumped into the sterilizer, which it enters at the bottom and leaves at the top. The coarse impurities of the water are filtered off by means of a quick filter, before the water is sterilized by the ozone. He gives some details of various tests. The sterilizing result is said to be at least as good as with other ozonizing systems; a brief comparative table of such systems is given. The cost of ozonization is said to be 1/16 to ⅛ cent per cubic meter. The cost of installation is not given, as it is said to depend upon the local conditions. Sterilization by ozone is generally superior to central sand filtration. It is proposed to introduce ozonization at the water works in Rotterdam.—*Zeit. f. Elektrochemie,* July 24.

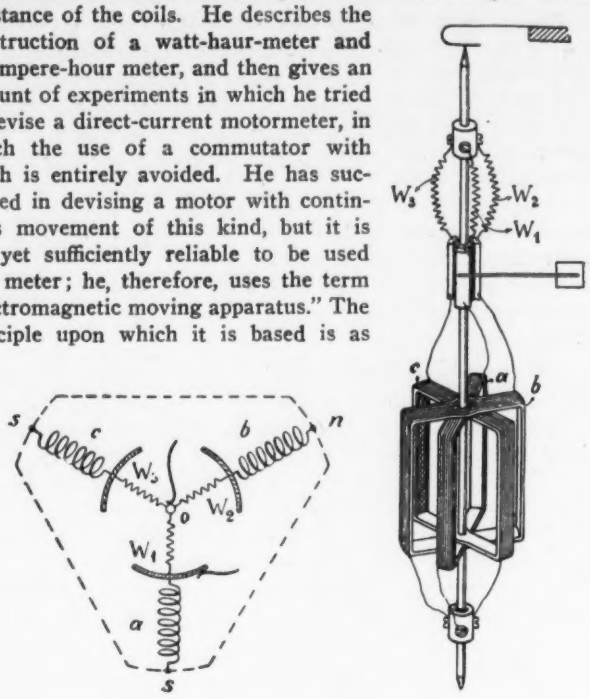
REFERENCES.

Electrolysis of Chlorides.—MUELLER.—An illustrated account of an experimental investigation of "the electromotive behavior of the hypochlorous acid and of chloric acid." The great difference of the results obtained with plain platinum anodes used with platinized platinum anodes is pointed out.—*Zeit. f. Elektrochemie,* July 3.

Course in Physical Chemistry.—LOEB AND RIMBACH.—An illustrated article on the course in physical chemistry in the chemical laboratory of the University of Bonn.—*Zeit. f. Elektrochemie,* July 10.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Motor Meters.—BRUGER.—An illustrated paper, read at the recent annual meeting of the Association of German Electrical Engineers. In an ordinary direct-current motor meter the speed is proportional to the power only when the friction is negligible. If there is friction, a means must be provided by which the error resulting from the friction is annulled. Several such devices are described. He has worked, however, in another direction, endeavoring to avoid this error by making the friction negligible. He states that the axle friction is very small compared with the friction of the brushes sliding on the commutator; the latter is especially great, when a brush passes from one segment to another. He describes a device of Hartmann and Braun, in which the brush friction is made negligible by using three commutator segments and only one brush. How this is done is shown in the adjoining diagrams, Figs. 1 and 2. Three active coils, *a*, *b*, *c*, are used, arranged at angles of 120 degrees from one another. There are three series of resistances, w_1, w_2, w_3, each belonging to one coil. Between each resistance and coil the commutator segment is inserted. The three free ends of the series resistances are connected together and so are the three free ends of the coils. The current enters through the junction point of the three resistances and leaves the system through the brush sliding on one commutator segment. Two of the coils have always the same polarity, while the third one, through which a current of double the strength in the other two flows, has opposite polarity. For a given current and given number of turns the effective ampere-windings are the greater the greater the series resistances in comparison with the resistance of the coils. They make the former 15 to 20 times the resistance of the coils. He describes the construction of a watt-haur-meter and an ampere-hour meter, and then gives an account of experiments in which he tried to devise a direct-current motormeter, in which the use of a commutator with brush is entirely avoided. He has succeeded in devising a motor with continuous movement of this kind, but it is not yet sufficiently reliable to be used in a meter; he, therefore, uses the term "electromagnetic moving apparatus." The principle upon which it is based is as



FIGS. 1 AND 2.—MOTOR METER.

follows: Referring to the adjoining Fig. 3, the armature coils are each wound double, the twoparts of each double coil being connected in parallel with each other, and in series with all the other parts; the current flow through the whole series; each part of the double coils is in series with a small bifilarly-wound resistance spiral of bismuth, which is fixed to the armature and moves with it; the direction of winding of these coils is such that the currents in each pair flow in opposite directions around the armature, so that their ampere windings would ordinarily neutralize each other. These

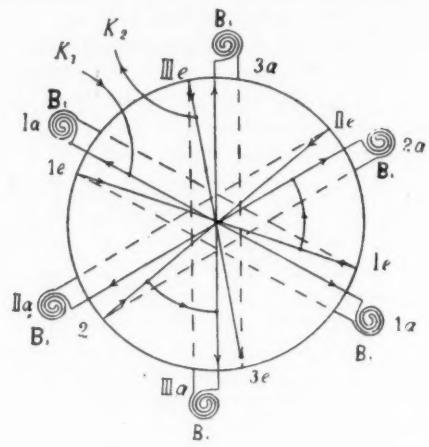


FIG. 3.—MOTOR METER.

bismuth spirals are so arranged that each is in a magnetic field during half of a revolution of a bipolar motor, and while in that field its resistance is greatly increased, owing to a well known property of that metal; consequent decrease of current in one of the two parallel coils enables the resulting excess of ampere-windings of the other coil to become effective in driving the motor, as the bismuth spiral of this other coil is during thattime outside of the magnetic field. With a field of 9,000 C. G. S. units he obtains an increase of resistance of nearly 40 per cent., so that the active current is always about 35 per cent. stronger. He applies the same principle to an oscillating pendulum motive device, diagrammatic illustration of which is given, as are also views of both the completed machines.—*Elek. Zeit.,* July 3.

Measuring the Iron Losses in Transformers.—GOLDSCHMIDT.—A communication in which he describes a method which he uses in iron tests and for measuring the no-load energy of small transformers. The iron body is provided with two windings, one consisting of a few turns, the other of many turns; the latter is connected to the voltage coil of the wattmeter, while the current flows through the former. With a small 120-volt transformer the no-load current was 0.5 ampere. The number of turns of the 120-volt winding was 80. The deviation of the needle of the wattmeter with the ordinary connections, was so small that it could not be used to take a reading. When the transformer was then excited by an auxiliary winding, consisting of four turns, and the 120-volt winding was connected to the voltage coil of the wattmeter, the deviation of the needle became 20 times larger. By this method, the copper loss in the exciter winding is not measured. The wattmeter gives the pure iron loss. It is easy to put on a separate current winding, as it consists of only a few turns.—*Elek. Zeit.*, July 17.

Standard Cells.—LUTHER.—A German Bunsen Society paper, in which he discusses the question of how great must be the degree of chemical purity of the electrolyte in order to obtain the required exactness. One Clark cell contained an impurity of 50 per cent. by volume of glycerine, the electrolyte in another Clark cell was pure; the difference of the e. m. fs. of the two cells was found to be 0.00744 volt at 25 degrees. From the theory which he advances, he draws an interesting conclusion: if the solid crystals in a standard cell with saturated solution (corresponding to the zinc sulphate crystals in a Clark cell with saturated zinc sulphate solution) are free from water of crystallization, then the e. m. f. must be independent of the impurities and of the solvent. He is trying to devise a practical standard cell for which this is fulfiled.—*Zeit. f. Elektrochemie*, July 24.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Space Telegraphy.—JACKSON.—A paper in which he gives a number of valuable observations concerning the transmission of wireless signals at sea across intervening land. He finds that some of the waves are capable of passing through, over, and possibly round the land, though in doing so their energy is reduced to an extent depending upon the height, extent and nature of the obstruction. He describes a remarkable case of an extremely precipitous, narrow, but high promontory, consisting of hard rock containing iron ore; the distance at which signals could be exchanged in the open sea was 45 miles, but the promontory cut them off entirely, the signals ceasing abruptly as the receiver disappeared behind the cliff. Limestone was found to be less obstructive, and sandstone still less so. Weather conditions also have an important influence, especially in sub-tropical regions; in the Mediterranean, a sirocco wind, holding moisture, salt and dust in suspension, absorbs the waves to a great extent. Lightning flashes always produce signals, and sometimes spell words in the Morse code, though the usual type is that of the letters e i in the Morse code. The absence of earthing in the receiver reduces the signalling distance by 50 or even 70 per cent., and its absence in the transmitter reduces it by 85 per cent.; but a condenser of suitable capacity acts nearly as well as a good earth. The air wire is practically indispensable, as he did not succeed in signalling over more than two miles without an air wire, even with good earthing.—*Proc. Roy. Soc.*, July 8; abstracted in Lond. *Elec.*, August 8.

REFERENCES.

Multiple Telegraphy.—ANIZAN.—The conclusion of his illustrated article on the Mercadier systems of multiplex telegraphy.—*Jour. Tel.*, July 25.

Statistics.—Statistical tables on the telephone service in 1900 in various countries of the earth, the United States not being included. Also the conclusion of the statistical report of the Postal and Telegraph Department of Italy for the financial year 1898-9.—*Jour. Tel.*, July 25.

MISCELLANEOUS.

Magnetic Separation of Zinc Blende.—A note stating that the magnetic separation of zinc blende from mixed sulphide ores by means of Wetherill magnetic machines, is now being carried on as a regular process at Denver, Colo. The crushed ore is separated into galena-pyrites and pyrites-blende classes. The latter is dried and then passed over the Wetherill machines, producing a blende which is sold to zinc smelters, and a pyrites product, containing some lead and about 5 to 7 per cent. Zn, which is united with the galena-pyrite; the mixture being sold to the lead smelters. The capacity of the zinc mill at Denver is about 40 to 45 tons of crude ore per day.—*Eng. and Min. Jour.*, August 16.

German Electrical Engineers.—A brief review of the recent annual Dusseldorf meeting of the Association of German Electrical Engineers. This association was founded in 1892, in order to further the commercial interests of the electrical, as well as the engineering and scientific interests in Germany. The latter purpose has been well fulfilled, but not the former; for this reason a separate society for protecting the common commercial interests of the German electrical interests has just been founded. The papers read at the Dusseldorf meeting will be noticed in the Digest as soon as published.—*Elek. Zeit.*, June 26.

German Bunsen Society.—As has been noticed before, the German Electrochemical Society at its last annual meeting changed its name into the German Bunsen Society for Applied Physical Chemistry. The first president is Dr. Boettinger, while Prof. van't Hoff, who was the first president up to the present, was elected second president. The number of members is now about 650. A good, brief, report of the proceedings by Danneel, with brief abstract of those papers which are of special interest to electrical engineers, appeared in the *Elek. Zeit.*, June 12. The different papers read at the meeting have been or will be duly abstracted in the Digest. A full report of the proceedings with reprints of the papers has begun in the *Zeit. f. Elektrochemie*, July 10, 17, 24, 31.

REFERENCES.

French Electric Industry.—MARMOR.—An illustrated article on machines built by the Society Schneider du Creusot.—*Cosmos*, July 26.

Conversazione.—STRECKER.—An illustrated description of the various apparatus and instruments exhibited at a recent conversazione of the Berlin Electrical Society.—*Elek. Zeit.*, July 10, 17.

New Book.

DIAGRAMS OF MEAN VELOCITY OF UNIFORM MOTION OF WATER IN OPEN CHANNELS. By Irving P. Church. New York: John Wiley & Sons. 11 diagrams and 1 page of text. Price, $1.50.

This book is intended to facilitate the application of Kutter's formula to practical work by giving its results in graphical form. Inasmuch as the practical application of Kutter's formula requires the estimation (guessing?) of a suitable "coefficient of roughness" for the particular case under discussion, the diagrammatic method will easily give all the accuracy attainable in the circumstances, and this is all the author claims for it.

BOOKS RECEIVED.

KOHLRAUSCH LEHRBUCH DER PRAKTISCHEN PHYSIK. By Dr. F. Kohlrausch. Leipzig: B. G. Teubner. 610 pages, illustrated. Price, 8.60 marks.

DIE INTERNATIONALEN ABSOLUTEN MASSE INSBESONDERE DIE ELECTRISCHEN MASSE. Fur Studirende der Electrotechnik in Theorie und Anwendung Dargestellt und Durch Beispele Erlautert. By Dr. A. von Waltenhofen. Braunchweig: Friedr. Vieweg & Son, 306 pages, 42 illustration. Price, 9 marks.

Directory of Electrical Societies, Etc.

AMERICAN ELECTROCHEMICAL SOCIETY, Secretary, C. J. Reed, Philadelphia, Pa. Next meeting, Niagara Falls, N. Y., Sept. 15, 16 and 17, 1902.

AMERICAN STREET RAILWAY ASSOCIATION, Secretary, T. C. Penington, 2020 State Street, Chicago, Ill. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Annual meeting, Hotel Kaaterskill, Catskill Mountains, N. Y., Sept. 2, 3 and 4, 1902.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. H. Johnson, Philadelphia, Pa. Next meeting, Mount Washington Hotel, White Mountains, N. H., Sept. 9, 1902.

CANADIAN ELECTRICAL ASSOCIATION, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

INDIANA ELECTRICAL ASSOCIATION, Secretary, Hal. C. Kimbrough, Muncie, Ind. Next meeting, Indianapolis, Sept. 17 and 18, 1902.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

NATIONAL ELECTRIC LIGHT ASSOCIATION, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 1903.

NEW YORK STATE STREET RAILWAY ASSOCIATION. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

NORTHWESTERN ELECTRICAL ASSOCIATION, Secretary, Thos. R. Mercein, Milwaukee, Wis.

THE OLD-TIME TELEGRAPHERS' AND HISTORICAL ASSOCIATION, Secretary, John Brant, 195 Broadway, New York. Next meeting, Salt Lake City, Utah, Sept. 10, 11 and 12, 1902.

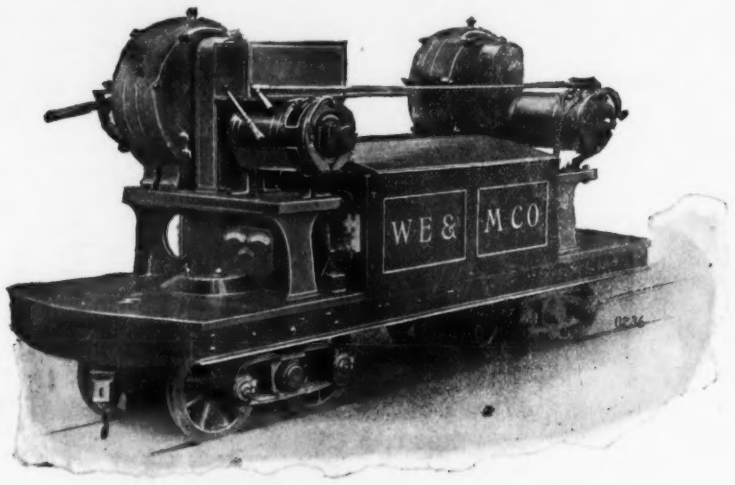
PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION, Secretary, John Ruth. Next meeting, York, Pa., Sept. 10, 1902.

U. S. MILITARY TELEGRAPH CORPS, Secretary J. E. Pettit, Postal Telegraph Company, Chicago, Ill. Next meeting, Salt Lake City, Utah, Sept., 10, 11 and 12, 1902.

VERMONT ELECTRICAL ASSOCIATION, Secretary, C. C. Wells, Middlebury, Vt.

Small Electric Locomotives for "Industrial Railways."

An industrial or narrow-gauge railway has become a very desirable addition for the transportation of material about the yards, buildings and bays of a large manufacturing plant. If the cars and loads are small, one man—and at the most two men—can push them from one part of the shop to another. However, if there are grades about the plant or large quantities of heavy material to be moved, recourse must be had to some greater power. The storage battery electric locomotive is an ideal motive power for the purpose. The



NARROW GAUGE ELECTRIC LOCOMOTIVE.

view of one now in service in the Westinghouse plant gives a very good idea of the form and arrangement of such a locomotive.

The battery, motors, controllers and gear cases are above the platform surface, so that all the vital parts can be inspected or repaired with the utmost ease. The locomotive is carried on two swiveling trucks with every wheel a driver, giving a maximum tractive effort, and enabling it to draw large loads and ascend heavy grades. It runs smoothly around curves of 12-foot radius so that all parts of works are accessible.

The battery is recharged at night or at intervals during the day when the locomotive is idle. It is divided into sections through the controller with the motor, armatures and fields in various series-parallel combinations. No rheostats or resistances are on the locomotive, and consequently there is no waste of energy in starting or running. Two Westinghouse vehicle-type motors are mounted, one driving each truck, and these are so exactly proportioned to the normal output of the batteries, and the weight of the locomotive that they are not, and cannot be overloaded by the motorman. One of these locomotives is capable of hauling about 50 tons on the level, and corresponding loads on grades.

Two of these locomotives were recently furnished to the Westinghouse Electric and Manufacturing Company and the Westinghouse Air-Brake Company by the C. W. Hunt Company, which company also supplied the industrial railway and all its equipment.

A Gasoline-Electric Dray.

Some few months ago we published a description of the Fischer combination gasoline-electric vehicles. The latest vehicle completed by the Fischer Company is a beer truck, for Jacob Ruppert,

FIG. 1.—GASOLINE-ELECTRIC DRAY.

the New York brewer. The view shown in Fig. 1 was taken of the truck while making its regular trip. At the time it was loaded with 83 half-barrels of beer, or very near nine tons.

In general, the dimensions of the truck is as follows: Total

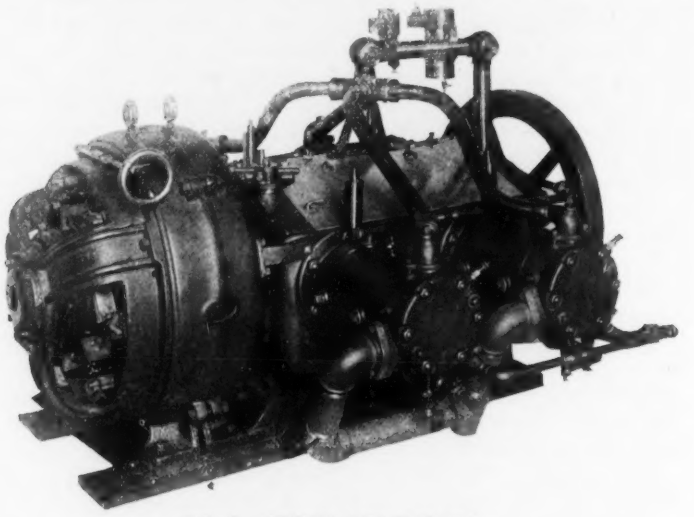


FIG. 2.—ENGINE AND DYNAMO.

length, 18 feet 4½ inches; width inside stakes, 5 feet; width over hubs, 7 feet 6 inches; wheel base, 10 feet 6 inches; size of wheel, front 36 inches, rear 42 inches; equipped with 7-inch Calumet solid rubber tires. Both front and rear axles are trussed. The front springs are

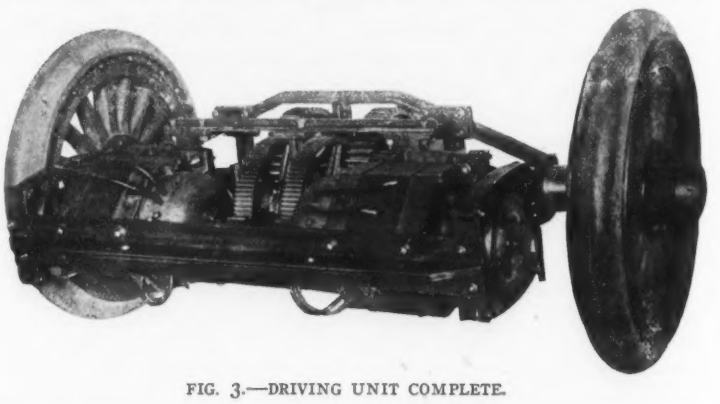


FIG. 3.—DRIVING UNIT COMPLETE.

of the platform type, the rear springs are half-elliptic with free sliding ends. All strain due to driving is taken up by push-rods from spring saddles to frame.

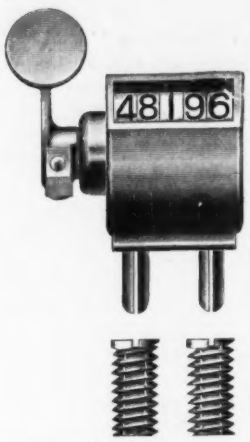
The power equipment consists of a 4-cylinder, 5½ x 6 gasoline

engine, coupled direct to a 9-kw, 110-volt dynamo, running at 550 r. p. m., approximately.

The two motors are of 8 hp, each capable of standing an overload of 150 per cent. The battery consists of 44 136-amp.-hour cells (3-hour rate). The controller has five speeds each way. The maximum speed is 4½ to 5 miles per hour, with full load on level. Fig. 2 shows the engine and dynamo complete. Fig. 3 is a view of the rear axle and motors assembled as a complete driving unit, but with the gear cases removed.

While the vehicle was being tested, it is reported to have hauled a 7½-ton load over a distance of 12 miles, one-third of which was up hill. At one place the grade reached 15 per cent. With the run completed, the gasoline tank was filled, thereby ascertaining how much fuel was used. It cost just three-quarters of a cent per ton-mile to haul the load for the 12 miles.

New Type of Telephone Counter.



TELEPHONE COUNTER.

The cyclometer is a widely familiar appliance in connection with the bicycle, but the Veeder Manufacturing Company, of Hartford, Conn., have of late been pushing the novel idea of applying it to telephony, and with considerable success. The Southern New England Telephone Company, of New Haven, Conn., and the Telephone and Telegraph Company, of Boston, have been testing the appliance for some time past, and report satisfactory results.

A glance at the counter, illustrated herewith, will at once suggest the manner in which it is to be attached and used. The purpose of the counter is to enable the superintendent of the telephone exchange to learn the number of calls each operator is answering per day, as well as the total number of calls answered by the exchange per day. A record is not secured every day, but once every two weeks, or possibly one day every month. If it is found that some girls are doing considerably more work than other girls, the work is re-distributed.

The two socket screws are intended to screw into the table flush, and in front but slightly to the right of the operator. The counter is attached at will by simply inserting the two pins into the two socket screws, and it is firmly held, as can be noted by testing the appliance. The operator after inserting the plug, and when returning her hand, presses the lever, and when this is done, the instrument registers one. The Veeder Company will supply the counters with levers pressing from or towards the operator, as may be preferred.

Telephone Switchboard.

The Western Electrical Supply Co. is placing a new telephone switchboard on the market, for which many claims of superiority are made. The combined drop and jack employed is claimed to be superior not only in mechanical design, but also, by reason of the armature being mounted on the front end of the coil, and the manner in which it is constructed, in electrical efficiency. It is stated that extensive tests have shown that only one-fortieth of the usual expenditure of electrical energy is necessary to operate this drop. Moreover, the simple construction of this combined drop and jack appeals very strongly to the practical telephone man, and combining these features with the compactness and general high grade construction of the switchboard, the manufacturers believe that it will appeal to all telephone engineers.

It is stated that the manner in which the armature is placed is a decided departure from other devices of this kind. The drop shutter when in the retained position rests squarely upon the armature itself, the rod that is customarily used for holding the shutter in place being discarded. Another change is that the armature does not operate on any hinge, but rests by its own weight on a knife edge at the bottom, which is on the principle of the most accurate weighing devices in common use. The space occupied by the complete structure comprising the combined drop and jack is only one by one and one-half inches, which makes the switchboard very compact. Still another point is that the mechanical restoring device is absolutely positive in its operation.

Telephone Service for a New Hotel at Indianapolis.

The Claypool Hotel, Indianapolis, now being constructed by the Indiana Hotel Company, will own and operate a complete telephone exchange, with a telephone in each guest room, as well as in the parlors and offices. The hotel is one of the largest, and when completed will be one of the finest and most modernly equipped houses in the West. The building and its furnishings will represent an investment of more than a million dollars.

The telephone service will be under the direction of the hotel management, and will be entirely for the convenience of the guests. It is intended to connect the hotel system with the public city exchange and State toll line system, so that long-distance connection may be made from any part of the house.

The equipment will be furnished by the International Telephone Manufacturing Company, Chicago, and will embody all of the improvements in this line recently evolved by this company. The system will be a full central-energy lamp signal, double supervisory switchboard equipment, with long-distance telephones.

The switchboard cabinet work and the telephone woodwork will be of solid mahogany for the parlor floors, of white walnut for the ladies' parlors, and will match the fittings throughout the house. The working parts of the system will have the same grade of work as in this company's public exchange equipment, and it is expected it will be one of the most modern and efficient hotel telephone systems ever installed.

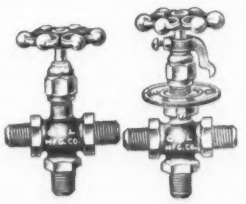
An Electrical "Snip."

The illustration herewith is that of the telephone or electrical snip now being manufactured by the Smith & Hemenway Company, 296 Broadway, New York City. This device is made from the highest grade material, and nickel plated. It is made very heavy and with a powerful leverage for cutting and stripping wire. It is a tool useful

ELECTRICAL "SNIP."

to any lineman, electrician, bell-hanger or anyone who in any way strings wire. The tool is up to the high standard of goods made by this firm in durability, finish, etc.

Three-Way Valves.


THREE-WAY VALVES.

The Clayton & Lambert Manufacturing Company, of Detroit, Mich., are making three-way valves, of the form herewith illustrated. They are used in large quantities by gas and gasoline engine makers, automobile builders and others. They are made out of close-grained, red-valve metal, and are furnished with and without dials, as shown.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money closed at 5 per cent. for thirty to ninety days. The stock market was somewhat unsettled and reactionary, although a strong undertone was exhibited. Western Union was very active and advanced to 95⅞ on pool manipulation, facilitated by vague reports of a possible combination of telegraph interests. It closed at the highest quotation—95⅞—a net gain of 2⅝ points, the lowest figure being 91¾. The sales aggregated 206,780 shares. Steel stocks were more active and firmer, common rising to 41⅝ and preferred to 90⅝. Tractions were weak and neglected. Brooklyn Rapid Transit closing at 66¾, a net loss of ⅛ point, and Metropolitan Street Railway at 147, a net loss of ⅞ The sales were 16,200 and 2,800 shares, respectively. General Electric was firm, closing at 187, being a net gain of 2 points. Westinghouse remains inactive, closing at 220. Other closing prices were: American District Telegraph 38½, a net gain of ½ point; American Telephone and Telegraph 173½, a net gain of 6½ points and Commercial Cable 165, a net gain of 8¾ points. Following are the closing quotations of August 26:

NEW YORK.

	Aug. 19.	Aug. 26.		Aug. 19.	Aug. 26.
American Tel. & Cable.	—	—	General Electric	185	192
American Tel. & Tel.	170¼	173½	Hudson River Tel.	—	—
American Dist. Tel.	—	39	Metropolitan St. Ry.	147¾	147¾
Brooklyn Rapid Transit.	67	67¼	N. E. Elec. Veh. Trns.	—	⅞
Commercial Cable	—	—	N. Y. & N. J. Tel.	—	—
Electric Boat	23	28*	N. Y. E. V. T. Co.	11½	11⅝
Electric Boat pfd.	30	41*	Tel. & Tel. Co. Am.	—	—
Electric Lead Reduc'n.	1¾	2¼	Western Union Tel.	92⅜	95⅝
Electric Vehicle	5½	5½	West. E. & M. Co.	—	224
Electric Vehicle pfd.	13	14	West. E. & M. Co. pfd.	—	—

BOSTON.

	Aug. 19.	Aug. 26.		Aug. 19.	Aug. 26.
American Tel. & Tel.	170½	173½	Western Tel. & Tel. pfd.	—	101
Cumberland Telephone	—	—	Mexican Telephone	2⅜	—
Edison Elec. Illum.	—	—	New Eng. Telephone	141½	142½
Erie Telephone	—	—	Westinghouse Elec.	—	—
Western Tel. & Tel.	—	30	Westinghouse Elec. pfd.	—	110½

PHILADELPHIA.

	Aug. 19.	Aug. 26.		Aug. 19.	Aug. 26.
American Railways	50	50¾	Phila. Traction	99¾	99¾
Elec. Storage Battery.	88	91	Phila. Electric	6¼	7⅛
Elec. Storage Bat'y pfd.	87	89	Pa. Elec. Vehicle	—	—
Elec. Co. of America.	8¼	8⅞	Pa. Elec. Vehicle pfd.	4	—

CHICAGO.

	Aug. 19.	Aug. 26.		Aug. 19.	Aug. 26.
Central Union Tel.	—	—	National Carbon pfd.	100	—
Chicago Edison	—	—	Northwest Elev. com.	—	—
Chicago City Ry.	206	211	Union Traction	16	—
Chicago Tel. Co.	—	—	Union Traction pfd.	50*	—
National Carbon	32¼*	42¼			

* Asked.

PHILADELPHIA BELL TELEPHONE.—A prominent official of the Philadelphia Bell Telephone Company says: "The company has about completed extensive plans for redistricting its downtown business. The plans involve important changes in four stations. The capacity of the station at Market Street, which was built to handle 5,000 connections, has been severely overtaxed by the rapid increase of business in that district, and it has become necessary to transfer some of the lines heretofore handled there to the station at Eleventh and Filbert Streets. The latter station now accommodates 4,000 lines, but will be rebuilt to accommodate 14,000. In addition to these changes, the capacity of the station at Seventeenth and Filbert Streets will be largely increased, and the station at Seventeenth and Poplar Streets, which now accommodates 2,000 connections, will be given a capacity for handling 16,000, to meet the growth of business in that district. The company has issued $1,000,000 additional stock, making total capital stock $10,000,000, leaving $2,000,000 authorized still to be issued of the $4,000,000 increase voted last April. There was a total gain of 13,785 stations, about 10,000 in Philadelphia and about 4,000 in Delaware and Atlantic, between January 1, 1902, and August 20.

FEDERAL TELEPHONE.—A telegram from Cleveland of August 24 says: The Everett-Moore syndicate has changed its plans with reference to the Federal Telephone Company, and no further effort will be made to bring about a reorganization of that concern. To-day it was learned that not a single company would remain the property of or in control of the Federal Telephone Company, and that that organization would shortly go out of existence. Henry A. Everett said that the intention is to fully protect the stockholders of the Federal Company and to bring about a dissolution of the company in about a month. The United States Teelphone Company and the Cuyahoga Telephone Companies will be handled as separate properties. A development with regard to the People's Telephone Company at Detroit, is expected soon and it is to be arranged by an attorney. It is believed that the money obtained from the sale of the smaller companies will more than offset the indebtedness of the Federal Telephone Company.

BOSTON EDISON.—The amount of the capital stock of the Edison Electric Illuminating Company, of Boston, has now been increased from $7,850,400 to $8,635,500 and the number of shares from 78,504 to 86,355. This issue is a little less than half the amount authorized to be issued by the Gas Commissioners. The directors offer to stockholders 7,851 shares at $200 per share, at the rate of one new share for every ten old shares now held by them. The right to subscribe will expire at the close of business October 8, 1902.

BELL TELEPHONE.—An official of the American Telephone and Telegraph says: "The subscription books of the company, which closed August 15, shows that practically all the new stock was subscribed for by the old stockholders. The present advance in the stock from around 163 to 172 has been principally on buying for New York account, judging from transfers, although there has been considerable buying for local account."

ELECTRIC STORAGE BATTERY.—A director of the Electric Storage Battery Company says: "No result will be reached as to the future of the Electric Storage Battery and Stanley Electric Companies until the fall. Mr. Whitney is out of town and Mr. Ryan is abroad, and action will certainly be deferred until Mr. Ryan returns in October."

MORTGAGE.—A mortgage for $2,000,000 has been given to the Federal Trust Company, of Cleveland, by the Baltimore, Washington and Annapolis Railway Company. The mortgage guarantees an issue of bonds for the completion of the road from Baltimore to Washington and Annapolis, an important article in regard to which appears in our present issue.

THE AUTOMATIC ELECTRIC COMPANY, of Chicago, has increased its capital from $2,000,000 to $3,000,000. This is the company which absorbed the Strowger Automatic Telephone Company last January.

BINGHAMTON BONDS.—It is stated that all the outstanding bonds of the Binghampton (N. Y.) General Electric Company, amounting to $700,000, are called for redemption.

DIVIDEND.—American Railways directors have declared a dividend of 1¼ per cent., payable September 16.

Commercial Intelligence.

THE WEEK IN TRADE.—Favorable conditions obtain in all sections, according to the reports received by the mercantile agencies, fall jobbing activity being widespread and reports as to collections being more uniformly encouraging than for some time past. Industrial activity has apparently never been surpassed. Gross railway earnings for the first half of August are 5 per cent. larger than during the same period last year, while the net returns for the first half of 1902, though reduced in May and June by strike influences, are nearly 5 per cent. better than for the same period in 1901, the best hitherto recorded. Fall trade is at its height at most of the leading centers, and buying is liberal; the Southwest reports the best trade in years. The lack of fuel threatens to make the shortage in pig iron acute; rails and structural material continue in heavy demand the country over, and machinery manufacturers are generally crowded to keep up with their orders. The end of the coal strike is yet a future event, although some isolated instances of collieries resuming are reported. Some Welsh coal has been imported but there is said to be little profit in it below $9 per ton. The business failures for the week ending August 21, as reported by *Bradstreet's* numbered 181, the same as the week previous, also the same as the corresponding week last year. The copper market was dull and featureless with prices a shade lower but in the buyers' favor. The closing quotations were: Standard, September-October, 10⅞@11¼c; Lake, spot to December, 11½@11¾c; Electrolytic, same delivery, 11.40@11.50c; casting, 11.35@1150c.

THE MANSFIELD ENGINEERING COMPANY, Mansfield, Ohio, will build a large power hourse and will purchase two generators, three boilers, two engines, compressors, etc. All machinery will be operated by motors, about twelve of which will be required.

EXPORTS OF ELECTRICAL MATERIALS.—The following are the exports of electrical materials and machinery from the port of New York for the week ended August 16: Antwerp—26 pkgs. material, $1,193; 12 pkgs. material, $1,531. Brussels—1 pkg. material, $100. Bristol—10 pkgs. machinery, $700. Barcelona—16 pkgs. machinery, $1,353. British Guiana—17 pkgs. material, $407. British East Indies—1 pkg. material, $25. Bilboa—7 pkgs. material, $550. Berlin—3 pkgs. material, $1,500. British Australia—3 pkgs. machinery, $115; 62 pkgs. material, $3,142. British West Indies—86 pkgs. material, $773. British Possessions, all others—4 pkgs. material, $194. British Possessions in Africa—54 pkgs. machinery, $3,414; 234 pkgs. material, $13,267. Colchester—2 pkgs. material, $153. Central America—12 pkgs. material, $375. Copenhagen—5 pkgs. machinery, $155. Cuba—34 pkgs. material, $766. Chili—13 pkgs. material, $967. Dutch West Indies—5 pkgs. material, $90. Ecuador—1 pkg. material, $210. Glasgow—5 pkgs. material, $225; 24 pkgs. machinery, $1,275. Genoa—80 pkgs. material, $1,165. Hamburg—12 pkgs. machinery, $1,524; 34 pkgs. material, $1,757. Havre—9 pkgs. machinery, $500; 30 pkgs. material, $1,250. London —74 pkgs. machinery, $2,729; 91 pkgs. material, $4,569; 17 pkgs. electrical cable, $2,168. Liverpool—271 pkgs. machinery, $18,765; 163 pkgs. material, $6,388. Manchester—117 pkgs. machinery, $13,665. Munich—2 pkgs. material, $220. Naples—2 pkgs. material, $10. New Castle—5 pkgs. machinery, $765. Newfoundland—10 pkgs. material, $75. Nova Scotia—22 pkgs. material, $224. Peru—14 pkgs. material, $453. Portsmouth—1 pkg. material, $82. Stockholm—1 pkg. material, $32; 1 pkg. machinery, $30. San Domingo—4 pkgs. material, $67. Saragossa—8 pkgs. material, $150. Tasmania—16 pkgs. material, $954. U. S. Colombia—9 pkgs. material, $520. Venezuela—4 pkgs. material, $69. Vienna—2 pkgs. machinery, $84.

ALLIS ENGINES IN SCOTLAND.—The following is reported from Glasgow by the *Iron Age*: The performance of the Allis engines at the Glasgow electric tramway station has never ceased to greatly interest all engineers, owing to the fact that the installation of American machinery in a station at Glasgow, the center of a great engineering district, involved much discussion. The question of early delivery was a prominent element in the decision of the Glasgow council, but the American makers were not satisfied with the kudos which came from the acknowledgment of the authorities that, but for the Allis engines, the electric tramways would not have been available at the opening of the exhibition. They have had exhaustive tests made by Professor Barr, of Glasgow University, whose reports carry conviction because of his skill and experience in such work. I have had a reading of the report, which is highly creditable to the Allis engine. The consumption of steam per indicated horse-power, as measured by the condensed water, proved to be 12.12 pounds, and the mechanical efficiency of the engines was 96 per cent. The engines of 4,000 indicated horse-power are coupled to 2,500 kw triphase electric generators and the ratio of the indicated horse-power to the electric horse-power proved to be 92 per cent. Mr. Parshall, the consulting engineer for the Glasgow corporation, commenting upon the report, says that the engines are working perfectly well in all respects and have been from the beginning.

ELECTRICITY IN ENGLAND.—"Apparently we are about to witness a kind of electrical boom," says a leading English financial journal. "This country has been singularly slow in adopting electricity. Former generations of Englishmen were quick to perceive the advantages of new inventions and to turn them to commercial account. But during the past quarter of a century or so there has been a strange apathy. There is no doubt that in regard to electricity we have fallen entirely behind the United States, Germany and France, and, indeed, some of the smaller countries, too. Perhaps there may be an ultimate advantage in this. We were the first in adopting railways, and no doubt part of their present unsatisfactory condition is due to that fact. From what we learn, it seems to be clear that a great development of electrification of railways is imminent. The Northeastern Railway Company has decided to electrify its Newcastle suburban lines. There is keen competition for all sorts of electrical railway enterprises here in London. Curiously, however, there does not seem to be keen interest in establishing great electrical companies. We have nothing in this country to compare with the leading electrical companies in the United States and in Germany. Whether the prospect of the electrification of railways will stir up our moneyed classes remain to be seen. If it does not, American and German companies will reap a handsome harvest, due to the inertia of our own manufacturers."

EDISON ORE PROCESS.—The English correspondent of the *Iron Age* writes: "All the preference shares for the Dunderland Iron Ore Company, formed to work the Edison magnetic process on the Dunderland estate, in Scandinavia, have been taken up. Operations have been vigorously commenced through the contracting company—the Standard Construction Company—and 1,500 men are already employed in making the line and otherwise preparing for the works. Sir David Dale, the chairman of the company, speaks very hopefully of the prospect. Sir J. Lawrence, M. P., states that the ultimate profit which the Standard Construction Corporation are to get out of this undertaking is not to exceed £40,000. The reason for the creation of the Standard Construction Corporation was, among other things, that a private contractor would charge a great deal more for carrying out the work than it could be done for by those specially acquainted with this class of undertaking, and it is computed that the Dunderland Ore Company save £200,000 by contracting the work through the Standard Construction Corporation. The Edison Ore Milling Company get no profit out of the Dunderland Ore Company, except in paper—that is to say, there is no cash profit."

FRENCH INDUSTRIALS.—Mr. Arthur Raffalovich, in *Le Marche Financier*, gives a list of industrial securities quoted on the Paris Bourse, showing the quotations at the end of 1900 and at the end of 1901. In almost every case the depreciation has been considerable. The crisis in industrial securities began in 1900, and, therefore, the comparison instituted by M. Raffalovich is not with the highest quotations. A few of the instances given by him will be instructive to show what heavy losses were incurred during 1901. The shares of the Compagnie de Traction, which were quoted at 156 at the end of 1900, were only 29 at the end of 1901. Those of the Compagnie Generale de Traction fell in the course of the year from 149 to 33; those of the Voitures a Paris from 260 to 153; those of the Bateaux Parisiens from 476 to 240; those of the Est-Parisien from 408 to 117; those of the Compagnie Generale Parisiene from 338 to 207; those of the Malfidano from 1,025 to 410, and those of the Fers et Aciers Robert from 123 to 54½.

WESTERN POWER COMPANY.—James D. Schuyler, of Los Angeles, connected with the Western Power Company, said recently that the company was actively engaged in carrying out its plans for an electric power transmission to San Francisco. Engineers and laborers are at work in the Big Meadows region on the reservoirs and tunnels that will be necessary for the completion of the great enterprise. This supply of water will supplement that which has been acquired by the purchase of the Big Bend Tunnel water system from Frank McLaughlin and his associates. It will cost about $500,000 to put this hydraulic system into proper condition to operate electric generators. The distance of transmission from the Big Bend tunnel site to San Francisco would be about 150 miles, while from the Big Meadows source it is about 180 miles.

ROBERT W. BLACKWELL & CO.—The following has been received from the above firm: "We beg to advise you that we shall close our branch office at 120 Liberty Street, New York, on the 31st of August, 1902. On and after that date, all our shipments from America will be in charge of Messrs. Lunham and Moore, Produce Exchange, New York City. All correspondence should in future be directed to our principal office, No. 59 City Road, London, E. C., England. Kindly advise your several departments to take immediate note of the above." The reason appears to be the domestic activity which prevents the export of various specialties, as prices are high, shipments are delayed, and some of the manufacturers are too busy even to quote for foreign orders.

FOREIGN ORDERS FOR SIGNALS.—The Northeastern Railway Company, of England, has awarded a contract to the Hall Signal Company, of this city, for the equipment of 10½ miles of its double track main line with the new Hall automatic normal danger block system of signals, from Alne to Thirsk. The award of this contract represents a probable revolution in the signaling of British railway lines, as it is believed that the Northeastern and many other British railway companies will adopt the American system for use over all their lines, in place of the English block system now in use.

AUTOMATIC TELEPHONE CONTRACTS.—The Automatic Electric Company, of Chicago—Strowger system—have recently been awarded the contracts to equip the independent exchanges in the cities of Columbus and Dayton, O., with their apparatus. Each of these exchanges is to have an ultimate capacity of 19,000 subscribers. The former is to have an initial installation of 6,000 stations, while the latter will begin, it is said, with 7,000 telephones connected up. These run far beyond anything attempted so far in the automatic telephone field.

OTIS ELEVATOR ORDERS.—This summer has been a remarkable season for the elevator industry, the Otis Elevator Company reporting that within the past week it has closed contracts for no less than 40 hydraulic passenger elevators, to be installed in New York City in large office buildings. Last week's orders include 51 electric elevators for New York City alone. Several of these are of the full automatic or push button type, where no attendant is required.

EQUIPMENT OF LOOM WORKS.—The contract for the entire electrical and mechanical equipment for the new Philadelphia plant of the Crompton and Knowles Loom Works, of Worcester, Mass., has been placed with Sargent, Conant & Co., of Boston. Power for the entire works will be transmitted and distributed electrically.

THE STANDARD VITRIFIED COMPANY, 39-41 Cortlandt Street, New York, was established July 1, 1902, and incorporated by Mr. R. W. Lyle, as president, and B. S. Barnard, vice-president and secretary. Mr. Lyle has had an experience of thirty-five years in the art of clay working, and of late years his time has been devoted entirely to the invention of different forms of conduit to be made in vitrified clay. He has recently had awarded to him four separate patents on multiple duct conduit, which this concern will put on the market. The company's factory, situated at South River, N. J., is one of the largest in the world, having 150 acres of stoneware clay, which will vitrify and make some of the best conduit known. It also proposes to manufacture a single duct conduit with self-centering joint. This is very economical construction, as an ordinary laborer can lay it. It requires no mandril or chalk lines, and aligns itself during construction. It also manufactures a third-rail insulator that is used on the Manhattan Elevated, New York City, and by the Westinghouse Electric Manufacturing Co., London, England. Mr. Barnard who has been in the electrical field for many years, is with Mr. Lyle, and from the experience of both of these gentlemen, both in manufacturing and following the trade closely, their success is assured. The company expects to have a capacity, at this one factory, of 25,000,000 feet a year. It is able to ship by water to all seacoast points, and by rail at very favorable rates. Its catalogue is in the printer's hands, though it is able to take orders at the present time and give immediate delivery. The ELECTRICAL WORLD AND ENGINEER has on many occasions referred to the conduit made by Mr. Lyle, and his new inventions should be more or less interesting to those intending underground construction.

MEXICAN WATER POWERS.—A great amount of United States capital is going into the Guanajuato mining district of Mexico, which gives promise of becoming one of the great mining fields on the American continent. The organization of the Guanajuato Power and Electric Company has been a factor in inducing the investment of capital in the district. This company will expend about $1,500,000 in harnessing the waters of the River Duero near the City of Lamora and transmitting power 110 miles to the City of Guanajuato. From the distributing station at Guanajuato the power will be transmitted to every mining district of importance in the vicinity. Chas. A. Coffin and John S. Barrett of the General Electric Company, E. Rollins Morse, John Hays Hammond and others prominent in mining and electrical circles, are identified with the company. The power plant will cost $1,000,000 and be completed in about a year. It will have an initial capacity of 3,000 hp and will be increased to 7,000 hp. It will make possible the extraction of millions of tons of low-grade ore that heretofore it has not paid to extract on account of expense of steam power. A large water power plant is also to be built in Mexico for pumping and lighting purposes at Parras and Viesca; also farms along the lines for a distance of forty miles. Water will be utilized from the mountain tunnel now being constructed at San Lorenzo. Capitalists at San Lorenzo, Parras and Viesca, State of Coahuila, are reported to be interested in the project.

RAW HIDE PINIONS IN ENGLAND.—Mr. A. Tait, assistant manager of the works of Messrs. George Angus & Co., Ltd., Newcastle-on-Tyne, England, and one of the largest leather manufacturers of the United Kingdom, recently spent two weeks in Syracuse, N. Y., having come to this country especially to visit the works of the New Process Raw Hide Company. An arrangement was made with Messrs. Angus & Co., by T. W. Meachem, president of the rawhide company, during a recent trip abroad, whereby the English concern is to establish a plant in England for the manufacture of rawhide gears and other products under the patents and processes of the New Process Raw Hide Company and using the latter company's trade mark. The plant it is expected will take care of the company's business not only in Great Britain but throughout Europe, Messrs. Angus & Co. having offices in nearly all of the principal cities and therefore being excellently situated to care for this trade. Upon Mr. Tait's return to England he will place orders with American firms for the latest gear making machinery and will proceed at once with the fitting out of the new factory, which will also be located at Newcastle-on-Tyne. Messrs. Angus & Co. have been the agents of the New Process Raw Hide Company in great Britain for eight years and have a well-established trade in these specialties.

DICK, KERR & CO.—English advices note that an amalgamation has taken place between Dick, Kerr & Co. and the English Electric Manufacturing Company of Preston. These two companies, along with the Electric Railway and Tramway Carriage Works, Limited, also of Preston, have previously been closely connected in engineering contracts, such relations being facilitated by the fact that Messrs. Dick, Kerr & Co. are the principal shareholders in both the other companies. It has been found, however, that persons having contracts at disposal could not quite understand the action of Messrs. Dick, Kerr & Co. accepting contracts and giving portions of them to the other companies. Therefore it has been thought advisable to bring the interests of each closer together by amalgamating with the English Electric Manufacturing Company, and it is stated that possibly in the near future the same proceedings may be taken with respect to the Carriage Works Company.

TRAIN LIGHTING CONTRACT.—The Consolidated Railway Electric Lighting and Equipment Company, of 100 Broadway, New York, has contracted with the Chicago, Rock Island and Pacific to equip with its "Axle Light" system of electric lights and fans all the cars now being constructed by the Pullman Company to be used in the new limited trains that go into service November 1 between Chicago and San Francisco via the Rock Island and Southern Pacific. This is the system of electric car lighting now in use on the twenty-hour trains of the New York Central and Lake Shore, and Pennsylvania Limited, and also on the finest trains of the Atchison, Grand Trunk, Chicago Great Western, Missouri Pacific and St. Louis and San Francisco, on the dining cars of other leading railway lines; also on all private Pullman caars, and on nearly all the official cars of railway presidents and general managers.

ALLIS-CHALMERS ENGINE SALES FOR JULY, included Milwaukee Electrical Railway and Light Company, Milwaukee, Wis., two vertical cross compound direct coupled engines, cylinders 28 in. and 60 in. by 49 in. (fourth order). American Steam and Wire Company, Pittsburg, Pa., six pairs of vertical cross compound steeple type plowing engines, steam cylinders 46 in. and 86 in. by 60 in., air cylinders 87 in. and 87 in. by 60 in., two vertical low pressure long crosshead blowing engines, cylinders 80 in. and 87 in. by 60 in. New Orleans Railways, New Orleans, La., two vertical cross compound direct connected engines, cylinders 38 in. and 80 in. by 60 in.

THE CLOVERDALE LIGHT AND POWER COMPANY which was recently incorporated with Asti, Sonoma County, Cal., as the principal place of business, will install a 600-hp electric plant. The directors are A. Sbarboro, P. C. Rossi and Alfred E. Sharboro, of San Francisco; W. T. Brush and C. E. Humbert, of Cloverdale. The power house and dams are now being constructed on Sulphur Creek, where electric power will be generated and transmitted to Cloverdale, Asti, Geyserville and other points. Contracts will soon be let for the machinery through the Engineering Offices, San Francisco.

WIRING PROPOSALS.—Sealed proposals will be received at the Supervising Architect's office, United States Treasury Department, Washington, until 2 o'clock P. M. on the third day of September, 1902, for the installation of a conduit and electric wiring system for the Hygienic Laboratory, United States Marine Hospital Service, Washington, D. C., in accordance with the drawings and specification, copies of which may be obtained at the discretion of the supervising architect. James Knox Taylor, supervising architect.

GENERATORS FOR JAPANESE ARSENAL.—The Japanese Government, through Rear Admiral Yamouchi, who has just sailed for the Far East, after a short visit to the United States, has placed a contract with the Westinghouse Electric and Manufacuring Company for two 400-kw generators and a number of motors, which will be installed for both light and power use in the Kure arsenal. It is anticipated that further contracts will be placed shortly after Admiral Yamouchi reaches Japan.

MAGNESIA COVERING CONTRACT.—The Philip Carey Manufacturing Company, Lockland, O., manufacturers of Carey's magnesia and asbestos sectional steam pipe and boiler coverings, etc., has been awarded the contract to furnish its 85 per cent. carbonate of magnesia covering for the power station of the Manhattan Railway Company, Seventy-fourth Street and East River. The contract amounts to approximately $25,000.

BALL ENGINE CONTRACTS.—Col. W. H. Dewey, Mampa, Ida., has purchased for his mines two engines built by the Ball Engine Company, Erie, Pa., which will furnish power for lighting. A 150 hp engine built by the Ball Engine Company is being installed at the Williams Brothers Company, pickle manufacturers, Detroit, Mich., and will be used for electric light and power.

LIGHTING PLANT FOR COSTA RICA.—The General Electric Company has secured a contract from the United Fruit Company, of Boston, for the equipment of an electric lighting plant to be built in Port Limon, Costa Rica. At present that Central American town employs kerosene for illuminating purposes.

SHANGHAI TRACTION SCHEME REJECTED.—The China house of Fearon Daniel & Co., 90-96 Wall Street, has received cable advices from its Shanghai office that the municipality of that Chinese city have rejected the electric traction propositions submitted last month by various electrical concerns.

THE PITTSBURG VALVE AND FITTINGS COMPANY is building new works at Barberton, O., and has placed a contract with the Westinghouse Electric and Manufacturing Company for the electrical equipment, which includes generators, motors and switchboards.

General News.

THE TELEPHONE.

COVINA, CALIF.—The Home Telephone Company of Covina has incorporated with a capital stock of $50,000. Directors: J. O. Houser, J. D. Reed, H. M. Houser, C. E. Crawford, all of Covina, and P. T. Spencer, of Los Angeles.

MONTREAL, CAN.—The Bell Telephone Company of Canada has secured a permit for a $20,000 addition to its building on Aqueduct Street.

COLORADO SPRINGS, COLO.—The Citizens' Telephone Company will ask the city council for a franchise to do business in this city.

PUEBLO, COLO.—Mr. J. E. Rizor and F. M. Merit and others petitioned the city council for a franchise to construct and operate a telephone exchange. It was granted with conditions.

AURORA, ILL.—The Inter-State (Northwestern) Telephone Company is building and equipping a plant at Springfield.

COFFEEN, ILL.—The City Council has granted the Citizens' Mutual Telephone Company a twenty-five-year franchise.

PEKIN, ILL.—The contract has been awarded for the construction of the Canton Home Telephone system to Jones & Winter.

PEKIN, ILL.—The Citizens' Telephone Company of Pekin was granted a fifteen-year franchise by the village of East Peoria.

WATSEKA, ILL.—Dr. N. I. Stringer has secured a franchise for an independent telephone company to string its wires about Watseka.

BLOOMINGTON, ILL.—A telephone line, to be owned and operated by the farmers east and southeast of Mason City, will probably be built.

SPRINGFIELD, ILL.—The Salt Creek Mutual Telephone Company has organized with G. W. Tracy, president; J. R. Hull, secretary, and John Martin, treasurer.

NEW ALBANY, IND.—The Cumberland Telephone Company has reduced its toll rate between this city and Louisville to 5 cents.

NEW CASTLE, IND.—Spiceland citizens have organized the Co-operative Telephone Company. Directors: J. T. Unthank, Dr. Jones, W. A. Poarch and others.

NEW CASTLE, IND.—Another gang of linemen has taken the place of the striking linemen and work on the New Castle Telephone Company's plant has been resumed.

DARLINGTON, IND.—The Darlington Co-operative Telephone Company has been incorporated with a capital stock of $2,000. It will operate a telephone line extending through Montgomery, Clinton and Boone counties. Among the directors is William N. Bowers.

COWAN, IND.—The Cowan Rural Telephone Company, capital stock $4,000, has been incorporated. Directors: Abraham McConnell, Charles Springer, George W. Kabrick, Philip Turner, William Clark, Lester H. Painter, Wesley B. Harbaugh and P. Perry Turner.

WABASH, IND.—A severe electric storm occurred here on Aug. 21, damaging telephone property to a considerable extent. Three hundred of the five hundred telephones of the Home Company were burned out, and the Bell Company lines suffered similarly.

EVANSVILLE, IND.—The Cumberland Telephone Company, that has been doing business in Evansville for the past twenty-five years, has been notified that it must quit business within ninety days. At a recent meeting of the city council an ordinance was passed to that effect. The franchise of the Cumberland, according to the advice of the city attorney, expired July 22 last. The Board of Works will ask for new bids, and if the Cumberland Company offers the best bid it will be accepted and a new contract entered into. Other companies will be asked to bid, but if the Cumberland Company tests the matter of limitation of its franchise in the courts the letting of a new contract may be delayed.

NEW ALBANY, IND.—The system of the Home Telephone Company, of this city, has passed into the control of the Home Telephone Company, of Louisville. Negotiations have been in progress for several months and have been completed in the past few days. The Louisville Company has already taken possession of the system and will make a number of improvements. A $12,000 switchboard is to be installed in the exchange. The two systems will be connected by a cable laid across the river on the Kentucky and Indiana bridge. The Louisville Company has orders for 6,000 telephones and has 3,000 in operation. It is believed that the merging of the two companies will result in the abolishing of the toll rates between this city and Louisville eventually.

INDIANAPOLIS, IND.—The final session of the State Tax Board is being given up to representatives of telephone companies that have appealed from the primary assessment of this class of property for taxation. A large number of telephone men were before the board pleading for a decrease in the valuation set against their companies. Hugh Dougherty, of the United Telephone Company, made a strong plea to have his company's valuation of $321,000 reduced to $154,000. He claimed that the method provided by law for arriving at the values of telephone property was not fair. The board takes the stock at a fair cash value, adds to that the indebtedness, and then deducts the assessment on real estate and personal property made in counties through which the company runs. Mr. Dougherty said that real estate owned by the company is assessed at about 45 per cent. of what the company paid for it and he claimed that it was unfair to assess real estate at such a low figure and then make a corporation pay on a cash valuation. A number of companies asked for a reduction on the ground of unprofitableness of the business, stating that they were bound by a low ordinance rate. In answer to a question by Governor Durbin as to what the future had in store for the telephone business in Indiana, Mr. Marvin, of the Frankfort Company, said he believed that men who put money in the business were beginning to realize the real situation. "I do not believe the use of telephones will be diminished," he said, "but companies will have to make a larger charge for their service. It is evident that within twenty years a company will have to rebuild its plant two or three times and this cannot be done on such a low rate." The board has primarily fixed the assessment on 134 companies operating upwards of 88,641 miles and the rate fixed is from $5 to $2,000 per mile.

STORM LAKE, IA.—The Northern Telephone Company is seeking a franchise in this place.

HAVELOCK, IA.—A telephone company is to be organized by the business men of this place.

GRINNELL, IA.—The Carroll County Telephone Company of Grinnell has been incorporated, with a capital of $75,000.

SHENANDOAH, IA.—The Independent Mutual Telephone Company has awarded a contract for a telephone exchange in this place.

DES MOINES, IA.—The Lone Tree Telephone Company has filed articles of incorporation; capital, $5,000. Incorporators: G. L. Day, J. M. Lee and others.

CRAWFORDSVILLE, IA.—The old telephone company has bought the Crawfordsville local system and will consolidate into one company.

DAVENPORT, IA.—All the electrical workers who could get employment have gone back to work for the Iowa Telephone Company, and declared the strike off.

CARROLL, IA.—What has been known as the new telephone system has been purchased by the Carroll County Telephone Company. The officers of the company are C. R. Morse, president; J. P. Lyman, vice-president; C. W. H. Beyer, treasurer; Louis Middeldorf, secretary. The company will run rural lines to all parts of the county and connect with the county seat.

UTE, IA.—The citizens of Ute have called a meeting for the purpose of organizing a telephone company.

SPRINGFIELD, MASS.—The City Council has granted the Home Telephone Company a franchise.

DETROIT, MICH.—A. M. Burton and others have filed articles of association of the Peninsular Telephone Company; capital $25,000.

ELBOW LAKE, MINN.—The Elbow Lake Telephone Company has increased its capital stock from $10,000 to $50,000.

WINDOM, MINN.—Jackson County is to have a telephone system. A company capitalized at $20,000 has been organized.

DULUTH, MINN.—The Duluth & North Shore Telephone Company, with a capital of $25,000, has been organized to build lines in St. Louis, Lake and Cook counties, Minnesota.

ARMSTRONG, MO.—The patrons of the Armstrong Telephone Company will not yield to the efforts of the company to increase its rates. At the mass meeting held Aug. 14, it was decided by the patrons that they would order their telephones taken out if the company attempted to raise its price. It is thought the company will yield.

HASTINGS, NEB.—The Adams County Telephone Company has filed articles of incorporation with the county clerk, capital $30,000. The officers are: J. N. Lyman, president; A. L. Clarke, vice-president; W. H. Waldron, treasurer; J. S. Logan, secretary.

LINCOLN, NEB.—Articles of incorporation of the Farmers' Mutual Telephone Company of Eustis, Frontier County, have been filed. The company is capitalized at $20,000. Its incorporators are John D. Anderson, William Walker, William G. Anderson, Daniel Phillips, Peter Kennan and George M. Campbell.

BOILING SPRINGS, N. C.—T. J. Hamrick and others have incorporated the Boiling Springs Telephone Company, with a capital of $1,000.

SOUTHPORT, N. C.—E. A. Perry and E. A. Pifer, of Chadburn, N. C., propose constructing a telephone line from Southport to Wilmington.

TRENTON, N. J.—The Monmouth Toll Line Company, which proposes to construct and operate a line of telegraph or telephone in New Jersey, has been incorporated, with a capital stock of $100,000. The incorporators are George Evans and C. Frederick Long, of Jersey City, and Henry F. Atkinson, of Newark.

AKRON, N. Y.—The Akron Telephone Company, of Akron, Erie County, has been incorporated; capital, $20,000; directors: J. M. Wethy, E. C. Porter, of Ripley, and F. R. Green, of Fredonia.

ITHACA, N. Y.—The Bell Telephone Company has moved into its new exchange on State Street in this city. The company has 800 subscribers in the city. The new equipment is on the central energy system.

ALBANY, N. Y.—The Charlotte Valley Telephone Company has been incorporated. The capital stock is $650. The directors are George Oliver, Meleatus Bruce, Richard Jeffers, Leslie D. Smith, Levi M. Stevens, Hiram D. Haner, Wallace Crapser, P. S. Taber and Nicholas Van Patten, of Charlotteville, and Arthur Hillas, of Worcester.

BUFFALO, N. Y.—The Grand Island Telephone Company has mortgaged its branches, privileges and property to the Bell Telephone Company for $2,500 for a period of five years. The directors of the Grand Island Company are Frederick H. Williams, Josiah P. Wright, Josiah Jewett, Jr., Francis J. Airey, J. Boardman Scovell and John V. Bedell.

POMEROY, OHIO.—The Citizen's Telephone Company will organize and ask for a franchise.

MARION, OHIO.—The Marion County Telephone Company has applied for a franchise in Prospect.

NEW ATHENS, OHIO.—The Flushing Telephone Company is installing a branch exchange at this place.

EAST LIVERPOOL, OHIO.—The Bell Telephone Company is constructing new lines in Carroll County.

GALION, OHIO.—Numerous improvements are being made in the exchange of the Galion Telephone Company.

TOLEDO, OHIO.—The Central Union Telephone Company will install a new board at its East Side exchange, to take care of 2,000 subscribers.

SCIO, OHIO.—Material has been ordered by the Harrison County Telephone Company of Cadiz for a branch exchange which it will establish at Scio.

CADIZ, OHIO.—The Junction Telephone Company will build a line to Cadiz Junction to connect with the lines of the Harrison County Telephone Company.

MANSFIELD, OHIO.—The Mansfield Telephone Company has settled its differences with its striking linemen and work on the system is now progressing.

BERGHOLZ, OHIO.—The Bergholz Telephone Company contemplates building a line to connect with the exchange of the Harrison County Telephone Company at Jewitt.

COLUMBUS, OHIO.—The Rockford Toll Line and Telephone Company, capital $10,000, has been incorporated to operate in Mercer, Van Wert, Darke and Auglaize counties.

MARION, OHIO.—The Marion County Telephone Company is building a line to Bucyrus by way of Caledonia. A large force is at work on the line which will connect up three exchanges.

NORTH LIMA, OHIO.—L. L. Peugh, of Canfield, is at work constructing the farmers' system of the Beaver Township Telephone Company. R. H. Ruhlman, of Youngstown, is president of the company.

XENIA, OHIO.—The Citizens' Telephone Company is constructing a new line from this place to Yellow Springs. It will abandon the old line which is strung on the poles of the electric railway company.

PORTSMOUTH, OHIO.—The Central Union Telephone Company is building long-distance lines connecting Portsmouth with Cincinnati. The company will put in several new local exchanges in this vicinity.

SHELBY, OHIO.—The People's Telephone Company will form a connection with 25 miles of farmers' lines to be built in the vicinity of Tiro. The lines will be owned by the Local Telephone Company of Norwalk.

CHICAGO JUNCTION, OHIO.—The Central Union Telephone Company has been refused a franchise in this town. The Local Independent Telephone Company defeated the proposed invasion of the Bell Company.

NORWALK, OHIO.—Senator J. F. Laning confirms the report that his syndicate has purchased a controlling interest in the Sandusky Telephone Company. The company is a prosperous one, having over 200 subscribers.

STEUBENVILLE, OHIO.—The Phœnix Telephone Company will build lines from Steubenville to Wintersville which will connect with the lines of the Harrison County Telephone Company, affording through connection from Steubenville to Cambridge.

FT. RECOVERY, OHIO.—The Ft. Recovery Telephone Company, which was organized some time ago, is enjoying remarkable progress. It has recently installed a central energy board and has 350 telephones installed. It has in operation about 65 miles of metallic circuit.

HAMILTON, OHIO.—The Miami Telephone Company is moving into its new exchange in the Merchants' National Bank Building. It is completing the work of installing new switchboards and four miles of cable, and considerable underground work. The system has been changed to the full metallic.

MANSFIELD, OHIO.—The syndicate headed by Senator Laning, of Norwalk, has practically closed a deal for the purchase of the Everett-Moore holdings in the Mansfield Telephone Company. Mr. Laning's syndicate is building up an immense system of independent exchanges in Northern Ohio.

CRESTLINE, OHIO.—The Crestline Local Telephone Company has been incorporated, with $50,000 capital stock, by J. Brobst, C. E. Shiner, J. F. Laning, F. J. Morkel and A. B. Kinsey. The company is identified with the Local Telephone Company of Norwalk, of which Mr. Laning is president.

TOLEDO, OHIO.—The Home Telephone Company has begun business in Toledo with 4,200 telephones and long distance connections. It is independent of the Bell interests. Much of the stock is owned in Cleveland and Elyria. It has long distance traffic contracts with the United States Telephone Company, of Cleveland.

CINCINNATI, OHIO.—A meeting of leading independent telephone people of this vicinity was held in Cincinnati last week and there are indications that prominent people are about to make another attempt to secure a franchise for an independent company. Cincinnati is the only city in Ohio without independent service.

TOLEDO, OHIO.—The United States Telephone Company expects to have its switching station at this point in operation about Sept. 1. The exchange is located in a separate building from that of the Toledo Home Telephone Company. The switchboard will have a capacity of 60 toll lines. The completion of the exchange will connect the Michigan and Indiana systems with Ohio, Pennsylvania and New York.

KENTON, OHIO.—The grocers' association has decided that using two telephones in their stores is unnecessary. Hereafter they will only use one line, but which one has not yet been determined upon. There are two lines here, the Bell and the Kenton Telephone Company. The rates are the same, but the Kenton Company, in which there is considerable local capital, has almost twice as many subscribers.

CINCINNATI, OHIO.—The City & Suburban Telephone Association has adopted a rule providing that a person using a pay station must pay a nickel for a call whether the party wanted is secured or not. The Ohio Valley Druggists' Association has passed a resolution protesting against the measure, and an attorney has been retained to examine the legal phases of the matter preparatory to bringing an injunction suit.

VERMILLION, OHIO.—The newly organized Vermillion Telephone Company has secured 125 subscribers and, it is claimed, about 70 of these are at present subscribers to the Bell system, but will drop the service when the new exchange is completed. Rates are $12 for residence service, $18 for country lines and $24 for business telephones. Lines will be built to Birmingham and other towns in the vicinity. Work is being started.

CLEVELAND, OHIO.—The United States Telephone Company has just completed long-distance connection with Charleston, Huntington and a number of towns in southern West Virginia. The new line crosses the Ohio River at Ironton suspended from two 90-foot steel towers, the span being 3,600 feet of ten phono-electric No. 8 gauge wires. Connection from Cleveland to Charleston, 400 miles, is made with only two switches. By doubling back into Ohio, the West Virginia exchanges are afforded connection with all parts of Pennsylvania through the lines of the United States Company. The Michigan connections will be completed in September. It is stated that there are, in round numbers, 106,000 independent telephone subscribers in Ohio, 34,000 in southern Michigan, 65,000 in Indiana, 20,000 in western Pennsylvania and 12,000 in West Virginia.

PORT CLINTON, OHIO.—Another deal of considerable magnitude has been consummated here in the sale of the Port Clinton Home Telephone Company's complete plant to the Ottawa County Telephone Company, which latter company will now incorporate for $150,000. The property involved in the sale of the local plant includes the cable to Put-in Bay and Middle Bass islands, several hundred miles of lines, toll and central stations on the islands, Catawba Island, Picolo, Gypsum, Peachton, Lakeside, Marblehead, Danbury, LaCarne, Locust Point and Nina, besides the 400-telephone exchange at Port Clinton. The absorbed Port Clinton Home Telephone Company was but a short time ago incorporated for $40,000, the new cable to the islands also having been laid but a short period since at an outlay of over $12,000.

NORWALK, OHIO.—The syndicate headed by Hon. J. F. Laning, of this city, is building up an independent system in this section of Ohio which promises to rival in importance the system formerly controlled by the Federal Telephone Company. The latest reports of the Local Telephone Company, as the parent organization is called, shows that it controls 14 exchanges, 31 toll stations, having an aggregate of 2,548 telephones and nearly 200 miles of country line, with a large number of farmer subscribers not included in the above. The syndicate is just completing a deal for the control of the independent system in Erie County, having 6 exchanges, 10 toll stations, 190 miles of country line and 1,600 telephones. Negotiations are on for the purchase of independent lines in Richland County, including 7 exchanges, 12 toll stations and about 1,600 subscribers. It is expected when the consolidation is fully completed, the Local Telephone Company will have over 6,000 subscribers, with 27 exchanges, 53 toll stations and 450 miles of country lines. Its exchanges at Wakeman, Berlin Heights, Greenwich and New London are being rebuilt and exchanges at Norwalk, Shelby, Chicago Junction and Crestline are being enlarged. The syndicate is not consolidating the various properties into one company, but will continue to operate them as separate units, each on a separate financial basis. The systems will be standardized and made uniform and by the practice of general economies of operation, it is expected the various plants will be placed on a high earning basis. The Local Telephone Company of Norwalk is to be the parent company, owning a controlling interest in the underlying companies.

STROUD, OKLA.—The S. S. S. Telephone Company, capital stock $10,000, has been incorporated by E. Brown, J. Noble, E. Mines and others.

WEST FORD, PA.—The West Ford Independent Telephone Company has been incorporated with a capital stock of $1,350.

PITTSBURG, PA.—It is reported that the Pittsburg & Allegheny Telephone Company will erect a new telephone building at the northwest corner of Fourth Avenue and Grant Street.

MEMPHIS, TENN.—A charter was granted to the Tennessee District Telegraph Company of Memphis, with a capital stock of $100,000. The incorporators are E. Howard, J. Compton, W. T. Gentry, James Merrihew and George H. Fearons.

CLEBURNE, TEXAS.—Cleburne & Bono Telephone Company, capital stock $1,000, has been incorporated.

COOPER, TEXAS.—The Texas Long Distance Telephone Company has been incorporated with a capital stock of $25,000.

WHITEWRIGHT, TEXAS.—The Whitewright Telephone Company, capital stock $10,000, has been incorporated by W. A. Fain, R. May and L. Selph.

AUSTIN, TEXAS.—The Texas Telephone Manufacturing Company, capital stock $10,000, has been incorporated by O. L. Brailey, A. E. Jeayons and H. Snelling.

ITASKA, TEXAS.—The Citizens' Telephone Company, of Itaska, has been incorporated by P. R. Stephens, L. E. Kerr, W. M. Buchanan and others. The capital is $10,000.

ORANGE, TEX.—The Orange Telephone Company, the new independent line, is preparing to make extensive additions to its system here.

FAIRMOUNT, W. VA.—For the second time within a few weeks, the exchange of the Consolidated Telephone Company has been burned out, owing to crossed wires. Nearly all the telephones were thrown out of service and the loss on the switchboard which is practically new, was over $1,500.

MILWAUKEE, WIS.—The settlement of the linemen's strike by the Wisconsin Telephone Company was a compromise, the men are to get $2.40 a day, instead of $2.30 formerly received and $2.50 asked, and the foremen $2.80 a day instead of $2.70 as before and $3 asked. The hours of work will be the same. The men in the country will have monthly paydays and the Milwaukee men semi-monthly. It is estimated that only 100 of the 300 men in the State who struck are at present in Wisconsin.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CALIF.—The United Gas and Electric Company, which has a 30-year contract for distributing the current of the Standard Electric Company in Santa Clara and San Mateo counties, is consolidating the plants of the three companies that were bought out. The combined plant is located in San Jose, Calif. Out of the $900,000 bond issue, $700,000 has been taken and the remaining $200,000 has been offered.

THOMPSONVILLE, CONN.—The Hartford Carpet Company will substitute electricity for steam power in its big mills here. Work has been begun on a power house, which will contain twenty-four boilers and four engines of 7,000-hp each, to drive generators.

NEW HAVEN, CONN.—The Housatonic Mfg. Company, of New Haven, has built a new plant to make all kinds of metal work, including electric light fixture trimmings. The power house, a separate brick building, 45x85 feet, is equipped with Heine safety boilers and Westinghouse engines of the compound vertical type, and the latter, belted to Westinghouse generators, supply current for the motors in the different departments.

ATLANTA, GA.—While the Atlanta Electric Company has been petitioning council for the right to bring its power from the Chattahoochee river into the city, another company, the Atlanta Water Power and Electric Company, has been building a 50-foot dam across the river, six miles above the proposed plant of the first company. The object of both companies is to deliver electric power in Atlanta. Among the gentlemen interested in the company are Jack J. Spaulding, Forrest Adair and S. Morgan Smith, of York, Pa.

HOUGHTON, MICH.—The Houghton County Electric Light Company has been incorporated with a capital stock of $1,300,000. Lawrence A. Ford, of Beverly, Mass., is the manager. Boston men are interested in the Houghton County Street Railway Company and the Peninsula Electric Light & Power Company, which will be taken over by the new organization, with headquarters at Boston. Extensive improvements are contemplated.

ST. LOUIS, MO.—The lighting of municipal buildings will cost the city $7,650 more during the coming year than the one just closed, unless the Board of Public Improvements rejects the bids received Aug. 15. Last year the Missouri Edison Electric Light Company supplied electricity to all the public buildings south of Washington Avenue at 6 cents per kw-hour. The bid of the same company for supplying light this year is 7½ cents per kw-hour. The Laclede Gas Light Company's bid of 8 cents per kw-hour for supplying electricity to the public buildings north of Washington Avenue is the same as last year. The talk of building a municipal lighting plant is said to be responsible for the increased cost of electricity.

OMAHA, NEB.—The Thomson-Houston Electric Light Company has placed a large force of men at work on its new conduit system, which, when completed, will have cost the company $200,000. All main wires in the business district will be placed underground.

CAPE MAY, N. J.—The Cape May Light and Power Company has been incorporated; capital, $15,000. Incorporators: Edward C. Brainard, Chicago; Edward E. Mandeville, Camden, S. C.; and James M. E. Hilreth, Cape May City.

NEWBURGH, N. Y.—The Newburgh Electric Light, Heat and Power Company has commenced the work of stringing its wires to Marlborough. The company will hereafter supply the village with light.

BALDWINSVILLE, N. Y.—The Baldwinsville Light and Heating Company, Baldwinsville, has been incorporated; capital, $100,000. Directors: Jacob Amos, W. F. Morris, W. H. Wells, Baldwinsville.

CHEVOIT, OHIO.—The village has called for proposals for lighting with electricity.

MANCHESTER, OHIO.—The village is offering $8,000 in 5 per cent. bonds to provide for the building of a municipal lighting plant.

MARIETTA, OHIO.—Business men of Marietta are planning to build electric arches on the main business street. The lighting plant will have to be enlarged if the plan is carried out.

COSHOCTON, OHIO.—The Coshocton Light & Heating Company has been incorporated with $250,000 capital stock. W. A. Himebaugh, J. D. Steverns, and T. L. Montgomery are interested.

CALEDONIA, OHIO.—The C. D. Resler Electric Light & Power Company, recently incorporated, needs some house chandeliers, fixtures, meters, etc. Mr. C. D. Resler is the general manager of the Company.

MANSFIELD, OHIO.—The Mansfield Engineering Company has begun work on a new power house to contain one compound engine, one simple engine, one air compressor, three boilers and two electric generators. All machinery in the plant is to be equipped for electric drive, and about 12 motors ranging from 1½ to 50-hp. will be required.

COLUMBUS, OHIO.—The board of public works has been instructed to cancel the advertisement for bids for the erection of the municipal lighting plant under plans which call for the expenditure of $175,000, and to prepare new specifications for a plant to cost about $110,000. The director of public works was enjoined from spending the larger amount.

PITTSBURG, PA.—Chief Engineer W. H. Brown, of the Pennsylvania Railroad, is drawing up plans for a power plant to be erected at South Thirteenth Street, this city. The plant will furnish the electric current for the signal and pneumatic power of the Monongahela division.

SPARTA, TENN.—Dr. W. B. Young, who recently purchased the Young & Simpson flour mill, near this town, may introduce electric power for its operation.

NORFOLK, VA.—The People's Light and Power Company, chartered with a capital stock of $100,000, has applied to the councils for a thirty-year franchise to operate an electric lighting and power plant. This is the second independent company organized during the past year to oppose the consolidated companies, which are controlled by the Williams syndicate, of Richmond. The first company was absorbed by the Williams' interest some time ago, and is now a part of the Norfolk, Portsmouth and Newport News Company, which is the name of the consolidated concerns. John G. Tilton, president of the new independent company, is Commonwealth's attorney of Norfolk, and he claims that his company can furnish lights and power cheaper than the present rate and will do so if granted a franchise by the councils. The application was referred to a committee.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—The Commonwealth Mining Company, which owns the famous Pearce mine, contemplates the construction of an electric railway. It will extend from Cochise station, near Wilcox, Ariz., on the Southern Pacific Railroad, to the mining property, a distance of 19 miles.

JACKSON, GA.—The Jackson Street Railway Company will build a power plant on the Ocmulgee River, about 7 miles from here, to supply the city with light and power for the proposed new railway system. W. F. Smith is general manager.

INDIANAPOLIS, IND.—The New Castle, Muncie & Alexandria Traction Company has been incorporated with a capital of $10,000. The directors are E. L. Ice, F. P. Ice, Clay C. Hunt, John H. Davidson and J. F. Tompson.

JEFFERSONVILLE, IND.—The Chicago syndicate, which has recently consolidated the heating, lighting and traction interests of New Albany and Jeffersonville, Ind., has decided to undertake immediately the construction of the proposed electric line between those two cities. This line will be known as the Jeffersonville, New Albany and Sellersburg Electric Railway, it being the plan to undertake an extension to the latter town soon. Louis Schenck, of Seymour, Ind., will be the president of the road. The Tennis Construction Company will build the line. C. C. Tennis, of Cincinnati, representing that company, is here making arrangements for the commencement of work.

BRUNSWICK, ME.—The Portland & Brunswick Street Railway Company has opened its new road from Freeport to Yarmouth for public travel, and cars are now running between Yarmouth and Brunswick. By the opening of this road Brunswick, Lewiston and Bath are put in electric car communication with Portland, making one of the largest trolley systems in the country.

BALTIMORE, MD.—The Union Trust Company, of this city, has closed the underwriting syndicate for an interurban trolley line which will fill a link in the long-distance trolley railroad between New York and Philadelphia. The underwriting covers an issue of $600,000 of first mortgage 5 per cent. bonds of the Philadelphia, Bristol and Trenton Electric Company. The trolley line will run from Torresdale, a suburb of Philadelphia, via Bristol, Pa., to Trenton, N. J. The company will have a capital stock of $1,000,000 and an authorized bond issue of $1,000,000.

LINCOLN, NEB.—Minority stockholders of the Lincoln Traction Company have called a meeting to protest against the action of directors in contracting with the Lincoln Heat & Power Company for heat and power at what they claim is a direct loss. Large stockholders of the Traction Company are said to have organized the Heat & Power Company. A majority of the stock of the Traction Company is held in New York City.

NEW HAMPSHIRE.—Mr. Wallace D. Lovell, the New Hampshire street railway magnate, is quoted as saying that he has secured valuable privileges in the White Mountain district, in which he proposes to generate electricity for the purpose of operating electric lights and electric cars. Mr. Lovell, it is understood, has a plan for threading the White Mountain district with electric lines to connect with his other rural lines. It is believed that this can be done with profit. The plan of lighting the district has long been discussed, but never put into operation. The power can be generated at the various stations along the electric lines.

BUFFALO, N. Y.—The capital stock of the International Railway Company has been increased from $10,120,500 to $17,000,000. This is one of the first steps in the consolidation of all the local lines financed by the International Railway Company. During the year the Crosstown Street Railway Company will also be merged and the capital stock will then be still further increased. The International Railway Company now represents the following fourteen trolley lines and bridge companies in Buffalo and along the Niagara frontier: The Buffalo Railway Company, Buffalo Traction Company, Buffalo & Niagara Falls Electric Railway Company, Buffalo & Lockport Railway Company, Buffalo, Bellevue & Lancaster Railway Company, Niagara Falls & Suspension Bridge Railway Company, Niagara Falls Park & River Railway Company, Niagara Falls, Whirlpool & Northern Railway Company, Lockport & Olcott Railway Company, Niagara Falls & Suspension Bridge Company, Clifton & Suspension Bridge Company, Queenston Heights Bridge Company, Lewiston Connecting Bridge Company, and Buffalo, Tonawanda & Niagara Falls Electric Railway Company.

KENTON, OHIO.—Hon. David Joy, president of the Findlay, Kenton, Bellefontaine & Urbana Railway, has applied for a franchise in Kenton.

HAMILTON, OHIO.—The Millcreek Valley Railroad Company will extend its line from Hamilton to Middletown. The new line will compete with the Southern Ohio Traction Company.

WAPAKONETA, OHIO.—The Western Ohio Railway Company is making arrangements to extend its lines from Celina through Rockford and Ohio City to Decatur, Ind., and thence west to Fort Wayne.

COLUMBUS, OHIO.—The Columbus, Newark & Eastern Traction Company has been granted a franchise by the Franklin County commissioners. The road will connect Columbus with Granville and Newark.

JEFFERSON, OHIO.—The Jefferson branch of the Pennsylvania & Ohio Railway is nearing completion and will be ready for business about the last of September. Rails are down and feed wires are being strung.

COLUMBUS, OHIO.—The Columbus, Newark, Zanesville & Wheeling Electric Railway Company has applied to the State canal commission for right of way over the canal towpath from Newark to the Stark County line.

MANSFIELD, OHIO.—The Phœnix Electric Company has completed and delivered to the Citizens' Street Railway Company of this city a 300-kw generator as an addition to its power house.

SPRINGFIELD, OHIO.—Plans for the building of the Springfield & Washington Traction Company from Springfield to Washington, a distance of 42 miles, are in the hands of construction companies, and contracts will be let at once.

TOLEDO, OHIO.—President A. E. Lang, of the Toledo Railways & Light Company, announces that the facilities of the company will be improved by the immediate expenditure of about $75,000. New car shops and barns are to be erected.

CLEVELAND, OHIO.—The Pennsylvania & Ohio Railway Company, now operating between Conneaut and Ashtabula, is endeavoring to make traffic arrangements with the Cleveland, Painesville & Ashtabula Railway whereby its cars may run through from Conneaut to Cleveland.

LIMA, OHIO.—The new Ft. Wayne, Van Wert & Lima Traction Co., which has recently succeeded another company of similar name, has organized with the following officers: James Murdock, Lafayette, president; H. C. Paul, Ft. Wayne, vice-president; L. C. Neely, Lima, secretary-treasurer.

CINCINNATI, OHIO.—Hon. A. S. Berry, of Newport, Ky., is at the head of a projected traction line to run from Covington to Milton, Ky., a distance of 65 miles. The ultimate object is to extend the line to Louisville. The Tennis Construction Company of Louisville is interested in the project.

CINCINNATI, OHIO.—The Cincinnati, Milford & Eastern Traction Company of Cincinnati has been incorporated with a capital stock of $10,000. The incorporators are Sumner B. Day, George H. Chamberlain, J. B. Irven, J. B. Wallace, Wm. R. Medaris and Senator Roudebush, of Clermont County.

YOUNGSTOWN, OHIO.—Mr. Andrews, 91 Ontario Street, Cleveland, Ohio, has charge of the purchasing of the supplies and equipment for the Youngstown & Southern Railway, whose organization was recently recorded in these columns. The company expects to begin construction work soon.

COLUMBUS, OHIO.—F. J. Green, general manager of the Dayton, Springfield & Urbana Railway, has been succeeded by Richard Emery, who will be general manager of all the Appleyard syndicate properties radiating from Columbus. Mr. Green will take charge of the construction work for the syndicate.

SPRINGFIELD, OHIO.—The Springfield & Xenia Traction Company placed its road in full operation last Sunday. It is reported that this company has made a traffic arrangement with the Dayton & Xenia Traction Company, whereby there will be through business from Springfield to Dayton in competition with the Dayton, Springfield & Urbana Railway.

TOLEDO, OHIO.—Officers have been elected by the Toledo, Fayette & Western Railway Company as follows: Judge C. M. Stone, president; F. E. Seagrave, vice-president; Luther Allen, secretary, and C. F. Franklin, general manager. The company will build an extension of the Toledo & Western Railway, and the officers of both companies are almost identical.

COLUMBUS, OHIO.—Electric roads centering at Columbus are agitating the question of asking the legislature to appoint a "State Inspector of Electric Railways," to regulate traction lines in the same manner in which steam roads are regulated. The idea is to have an officer who shall supervise the care of tracks, cars, overhead wiring, etc. The matter will probably be brought up at the coming special session of the legislature.

CINCINNATI, OHIO.—The Cincinnati, Dayton & Toledo Traction Company, formerly the Southern Ohio, is now operating cars to within three miles of the center of Cincinnati, utilizing the tracks of the old Cincinnati & Northwestern steam road, which it acquired some time ago. The struggle extending over more than two years has been ended by the dropping of the suit brought by J. C. Rodgers to prevent the operation of cars over the Cincinnati & Northwestern tracks and by the approval by the railway commissioners of the C. H. & D. crossing at Linden Avenue.

ALTOONA, PA.—The city council of Altoona has granted franchises to a street railway and an electric light company in competition with the American Railways Company and the Electric Company of America.

GALLATIN, TENN.—Mr. Percy Moore, vice-president and general manager of the Louisville, Anchorage & Peirce Valley Interurban Railway, is so well pleased with his line that he is offering $10,000 for the privilege of entering Nashville with a trolley line running from Gallatin, Tenn., a distance of 27 miles, and from Nashville to Columbia. The territory is the most thickly populated in Tennessee, and is a rich agricultural section with many towns.

NEW INDUSTRIAL COMPANIES.

THE POTOSNIA ELECTRIC COMPANY, of New York, capital $700, has been incorporated. Directors: F. H. Southwick, C. L. Rossiter, Brooklyn; W. P. Mason, New York.

THE ELECTRO-STERILIZING COMPANY, of Brooklyn; capital, $100,000, has been incorporated. Directors: W. R. Chipman, A. S. Castner, Brooklyn; Sylvester Eastman, Manhattan.

JAMES A. SPARGO WIRE COMPANY has been formed at Rome, N. Y., with a capital stock of $30,000, and has just completed a mill to make bare and tinned copper wire for the electric trade, etc.

THE PAN AMERICAN ELECTRIC LIGHT & POWER COMPANY has been incorporated at Jersey City to manufacture storage batteries, etc.; capital, $1,000,000. Incorporators: Edw. P. Schmidt, Thos. F. Barrett, K. K. McLaren.

THE MAXWELL M. MAYER ELECTRIC COMPANY has been incorporated in New Jersey to manufacture electrical supplies; capital, $100,000. Incorporators: Christian E. Hartshorn, Marshall L. Osgood and Paul E. Hirsh, all of Jersey City.

WILSON BELL CALL & FIRE ALARM COMPANY has been incorporated with a capital stock of $100,000, to make a new line of electrical bells and supplies. Mr. J. S. Craft is president and Mr. J. W. Wilson, vice-president. Its offices are at 319 Main Street, Buffalo, N. Y.

WALTER MOTOR & POWER COMPANY has been formed at Washington, D. C., with a capital stock of $1,000,000, to introduce the paddle wheel for power development of Mr. W. L. Walter, of Port Huron, Mich. Mr. H. Darneille is president; Mr. S. W. Smith, vice-president; Mr. F. Walter, secretary; Mr. B. H. Brockway, treasurer.

OBITUARY.

MR. T. NEVINS died suddenly at his residence, Mount Shannon, Castleconnell, County Limerick, Ireland, on August 21. He was well known as a contractor and large shareholder in many electric traction companies and lighting enterprises in this country. He resided when in this country at Holly Hall, East Orange, N. J. He and his son, Thomas A. Nevins, went abroad several months ago to look after certain franchises they had acquired for a trolley line between Liverpool and Manchester. He was born at Kells, County Mayo, Ireland, May 30, 1844. He came to the United States in 1864, settled in Orange and embarked in the contracting business. His early work was in connection with the macadamizing of streets and roads. He afterwards secured a bluestone quarry, which laid the foundation of his later wealth. He became interested in the development of trolley systems, and purchased and finally secured control of the street railroad interests of Detroit, Mich. In England Mr. Nevins had engaged to consolidate the main lines lying between Liverpool and Manchester, and convert them into trolley roads under the name of the South Lancashire Electric Traction Company.

PERSONAL.

MR. A. N. BRADY is credited by advices from Japan with having bought control of the gas works at Osaka and Tokyo.

MR. C. O. BAKER, JR., of Baker & Co., the platinum refiners, Newark, N. J., has been elected a director of the National State Bank of Newark.

MESSRS. KEMPSTER B. MILLER and W. W. DEAN, of the engineering staff of the Kellogg Switchboard & Supply Company, of Chicago, are on a hunting expedition in Colorado.

MR. R. C. BLISS has been appointed manager of the Western Union Telegraph Company at Cincinnati, Ohio. He has for some time been representative of the same company at Springfield, Ohio.

MR. C. D. SHAIN, once prominent in Edison and General Electric ranks in New York, is now devoting his energies and his great commercial ability to automobilism, in which he has already built up a large and profitable connection.

PROF. G. F. SEVER, recently appointed consulting electrical engineer to the Department of Gas and Electricity of New York City, will, it is understood, continue to hold his professorship in electrical engineering at Columbia University.

MR. E. H. McKNIGHT, who is at the head of the electric lighting company at Bowling Green, Ohio, has been appointed president of the Ohio Electric Light Association, succeeding Mr. W. T. White, of Cincinnati, who resigned recently.

DR. S. S. WHEELER, president of the Crocker-Wheeler Company, with Mrs. Wheeler and Mr. A. L. Doremus, was registered last week at Claridge's Hotel in London. The Wheelers have been making an automobile trip around the Continent.

MR. PH. SCHRIMPFF, of the Board of Directors of the Allgemeine Elektricitaets Gesellschaft of Berlin, is making a short tour in the United States, during which he will visit some of the larger manufacturing establishments and central and power stations.

MR. T. M. MESTON, secretary of the Emerson Electric Mfg. Co. of St. Louis, is a visitor in New York and the East, studying the general situation. Although the season has been phenomenally cool, Emerson fan output is considerably in excess of last year.

MR. G. W. HEBARD, of the Westinghouse Electric & Mfg. Company, and president of the Union Metallic Company, is one of the directors of the new International Harvester Company, which comprises five of the largest agricultural machinery concerns in the country.

COL. H. A. YORKE.—A cable dispatch from London says that the Times understands that Col. H. A. Yorke, Chief Inspecting Officer of Railways, has been commissioned by the Board of Trade to report on the working of American railway lines, both steam and electric.

MR. A. J. CORRIVEAU, a well-known Canadian in the field of electric lighting and electric railways, has been on from Montreal the last week and attended the automobile races at Brighton Beach. He is now largely interested in a commercial way in automobiles and has several important agencies for Canada.

MR. J. L. PUTNAM, manager of the Clark Automatic Telephone Switch-Board Company, Providence, R .I., has just returned from a trip throughout the Southern and Central Western States, and met with success in establishing companies for several small town plants, while others are in view for early operation.

MR. W. F. D. CRANE, who has been associated with Sanderson & Porter, 31 Nassau St., in an engineering capacity, has recently joined the forces of the American Stoker Company, 277 Broadway, New York, as manager of its contract department. Mr. Crane will have his quarters in the New York office of the company.

MR. JOHN A. WALKER, general manager, etc., of the Joseph Dixon Crucible Company, Jersey City, N. J., on his recent return from a business trip abroad, was presented by the staff with a sterling silver loving cup, having been

subscribed for by members whose service with the company dated from 1867 down to 1901.

MR. JAMES MERRIHEW, for many years general superintendent of the southern division of the Western Union Telegraph Company, has resigned, his retirement to take effect on Sept. 1. Mr. Belvidere Brooks, now general superintendent of the eastern division, will assume the general superintendency of the southern division in addition to his present duties, on Mr. Merrihew's retirement.

MR. EDWARD NOYES, of the Australian electrical engineering and contracting firm of Noyes Brothers, Sydney, which concern represents the Westinghouse and other American manufacturing interests in the Antipodes, is now in New York. He is accompanied by M. Hammond, of Auckland, who acts as sub-agent for the Noyes firm in New Zealand. These gentlemen are guests at the Waldorf-Astoria.

LORD BLYTHSWOOD.—The Marquis of Salisbury is not the only British peer who is a devoted student and experimenter in electricity. Lord Blythswood, a Scottish peer, is noted as an amateur electrical expert. He owns a splendidly equipped private laboratory, in which he spends hours at work. He has just given to the Glasgow Royal Infirmary a dynamo designed and built by himself and assistants.

MR. CESARE PIO, well known as an electrical engineer and as a contributor to these columns, has opened an office as consulting engineer at Milan, Italy, having as an associate Mr. Poggi. They will be glad to get into business relationships with American electrical manufacturers who desire to reach Italian trade as well as to perform technical service. They have opened offices at 18 Via Lazzaro Palazzi.

MR. HADYN T. HARRISON, M. I. E. E., of the English firm of Hadyn Harrison & Co., electrical engineers, is at present in this country for a short trip, making a study of electric lighting conditions. He would like to hear from anyone with good lighting specialties that can be placed on the English market, and can be reached, care of the ELECTRICAL WORLD AND ENGINEER. He is now traveling, but will sail for home next week.

MR. M. R. HUTCHISON.—A cable dispatch from England states that Mr. Miller Rees Hutchison, of New York City, who sailed for New York on August 22 on board the White Star Liner "Celtic," was summoned to Cowes before leaving, and received from Queen Alexandra a special coronation medal. Mr. Hutchison has been treating the Queen for deafness, but her majesty ascribed the gift to her recognition of Mr. Hutchison's services to deaf mutes in London, in whose welfare the Queen is greatly interested. Mr. Hutchison went to England early in May, on the same steamer as Lord Kelvin, to whom he was introduced.

Trade Notes.

THE BUCKEYE ENGINE COMPANY, Salem, Ohio, has shipped a large engine to Valparaiso, Chili, by the way of Cape Horn.

THE WARREN ELECTRIC & SPECIALTY COMPANY, Warren, Ohio, has moved into a fine suite of offices in a new office building. The Peerless Electric Company will have offices in the same building.

INCREASE OF CAPITAL.—The Nungesser Electric Battery Company, Cleveland, Ohio, has increased its capital stock from $25,000 to $100,000. A short time ago the company moved into a new and larger factory.

WAGNER BULLETINS Nos. 52 and 53 relate to "Static ground detectors" and "Type L" portable instruments for direct and alternating-current measurements, respectively. Both classes of instruments are illustrated and described.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., in bulletins Nos. 1062 and 1033, illustrate and describe, respectively, their differential type of enclosed direct-current series arc lamps and their integrating switchboard wattmeters, type K.

"WOOD" ARC LAMPS.—The Fort Wayne Electric Works, Fort Wayne, Ind., has just issued a folder giving a good deal of practical information regarding the "Wood" direct-current enclosed arc lamps for power circuits. The various styles of the lamp are illustrated.

TO MANUFACTURE SPECIALTIES.—The Bloom-Kloeb Company will erect a factory at Cridersville, Ohio, for the purpose of manufacturing electrical specialties. The company has entered into a contract with the village authorities to furnish light and power. Work on the plant is to start at once.

THE NORTHERN ELECTRICAL MFG. COMPANY, Madison, Wis., has just issued Bulletin No. 29 in excellent style. It is practically a reprint of No. 24, but contains 8 pages more of matter and many new illustrations, and serves in a more complete manner to show the variety and quality of Northern apparatus.

SUNBEAM LAMPS.—The Sunbeam Incandescent Lamp Company reports an unusually good business for the summer months, and the securing of several substantial contracts for export based upon the most rigid competitive tests seem to bear out the claims of the manufacturer, that the Sunbeam lamp is unexcelled.

THE BURT MFG. CO., of Akron, Ohio, has just received an order from the American Steel & Wire Co. for two large Burt exhaust heads and a 200-gallon Cross oil filter for its works at Cleveland, Ohio. The Burt Company mentions that this is the twenty-ninth order which it has received from this one concern for oil filters.

MACHINE TOOLS.—The Garvin Machine Company, Spring and Varick Streets, New York, in its August catalogue (No. 8), describes and illustrates its line of screw machines, monitor lathes, forming machines and double turret screw machines. The dimensions of the various machines are given, together with the principal data.

FISCHER OMNIBUSES.—Mr. S. M. Fischer, president of the Fischer Company, returned from London several weeks ago, where he succeeded in waking up the two largest omnibus companies. Both of them placed orders for omnibuses of the Fischer type. Several orders for similar heavy trucks were also booked by Mr. Fischer on his London trip.

THE MICA INSULATOR CO., of New York and Schenectady, announces that it is making an addition to its plant which will increase its output fifty per cent., and enable it to fill all orders very promptly. It was led to take this step in order to meet the increasing demands of the trade for its well-known specialties, micanite goods, empire goods and M. I. C. compound.

THE INTERNATIONAL TELEPHONE MANUFACTURING CO., Chicago, is said to be having a rapidly increasing demand for its improved long distance transmitters. This instrument, it is reported, is very neatly designed; constructed with the very highest class of workmanship; built along the most scientific lines, and is one of the loudest, most distinct and durable transmitters ever produced.

THE PITTSBURG INCANDESCENT LAMP COMPANY, which was recently organized, has started business in a temporary plant. A new plant will soon be erected, where will be carried on the business of manufacturing new incandescent lamps and renewing burned-out lamps. The company was organized with a capital of $25,000, and its officers are J. B. Tomb, president, and W. A. Hilands, secretary and treasurer.

SIGN LAMPS.—To meet the demand for a lamp in which the "end candle power" is of the first importance, such as in sign work, the Electric Appliance Company, Chicago, is now supplying what it calls a "Multiple Burning Sign Lamp," of which it has a special illustrated circular. This lamp is furnished in 4, 6 and 8 candle power, 45 to 130 volts, with any standard base. All bases are porcelain insulated and are attached with a water proof cement.

REMOVAL.—The Imperial Electric Company of Philadelphia has removed its business to No. 28 North Seventh Street, which is only six doors above the old location. It has leased the entire building, and secures, in consequence, greater facilities for the transaction of its growing business in incandescent lamps of all kinds and allied interests. Mr. Henry A. Truitt is proprietor. A sheet issued by Mr. Truitt shows a great variety of lamps handled by him.

TELEPHONE DRY BATTERIES.—The proprietors of the New Excelsior dry battery manufactory, 32-34 Vesey Street, New York City, have interested a large number of telephone companies in their dry batteries recently because of their willingness to send their batteries to any responsible, well-rated company, on six months' approval. "The proof of the pudding is in the eating," and a concern that can afford to do this must be making batteries of satisfactory efficiency.

BRECHT AUTOMOBILES.—The Brecht Automobile Company, St. Louis, Mo., gives much interesting information about its steam carriages, running gear for automobiles of all classes, supply parts, etc., in a 64-page catalogue of recent issue. This company builds an electric runabout of neat design. The motor is of 2½ horse power; the controller has three speeds forward and three reverse, and the vehicle, it is stated, will run 40 to 50 miles on one charge of the battery.

AMERICAN SHIPPING.—The *Marine Review*, Cleveland, Ohio, has issued the seventh annual edition of its Blue Book of American shipping. This book is a marine directory of the United States and deals with statistics of shipping, naval affairs, etc. The introduction of this edition is a *résumé* of merchant ship construction during the past year, and of the progress of the shipbuilding industry throughout the country. It contains a great deal of interesting information relative to the progress of American shipbuilding and navigation.

ELECTRICAL SUPPLIES.—The H. W. Johns-Manville Company, New York, has just issued a new catalogue of its electrical supplies, including a full line of overhead materials, heaters, rail-bonds, 500-volt fuses, vulcabeston and special molded insulated pieces, together with many new articles, such as double-trolley suspensions. The catalogue has 108 pages, including a complete table of contents at the front and an alphabetical index at the back, and is the largest and most comprehensive electrical catalogue ever produced by this company.

MEDAL FOR WAGNER MOTORS.—The Franklin Institute of Philadelphia has awarded the Edward Longstreth medal of merit to the Wagner Electric Manufacturing Company, St. Louis, Mo., on its single-phase alternating-current motors. The Institute committee, in its report, refers to this motor as a "meritorious contribution to science and the industrial arts." The Wagner Company has published in pamphlet form the committee's full report, together with individual reports of some prominent electrical engineers on tests of Wagner motors. The Wagner Company is justly proud of the distinction conferred upon its motors.

DENVER ENGINEERING WORKS COMPANY, of Denver, Colo., Mr. Lewis Searing, general manager, has just issued an excellent bulletin devoted to electric hoists for mining purposes. One of the main features of the bulletin is the general drawing of each hoist, accompanied by a table giving all of the dimensions which are necessary for the location of the hoist in the plans of the constructing engineer. It is to be noted that a great range of sizes is manufactured, and many prominent companies have given repeated orders for hoists. The Cripple Creek Mining District is a large user of these hoists, as can be seen by the large number of them purchased by the Colorado Electric Power Company which operates in the Cripple Creek District. The bulletin is quarto size, 32 pages, and well illustrated.

AUTOMATIC WATER MOTOR.—The Cassel Automatic Water Motor Company, Seattle, Wash., describes and illustrates its self-governing water wheels in a 76-page pamphlet of recent issue. It is claimed that this wheel governs its speed under all degrees of load within a variation percentage not exceeding that of Corliss steam engines under usual conditions of service. The principle empolyed in the Cassel wheel is that of centrifugal force as the basis of the automatic mechanism, acting in moving the buckets of the wheel out of the line of impact of the jet or flow of water, without interfering in the least degree with the free flow and velocity of the water. The various illustrations show different styles of the wheel, also actual applications to the operation of apparatus, including electric generators.

BEGINNING LIFE AT SEVENTY-FOUR.—The adage, "One is never too old to learn," has been exemplified so many times in recent years by men past middle age taking up courses in correspondence schools that it has grown to be an old story. However, the limit seems to have been reached when we hear of a man seventy-four years old taking up the study of electrical engineer-

ing. Among the men over fifty years of age enrolled with the American School of Correspondence, Boston, is Mr. George F. Carsley, staying at Fairhaven, Mass. Born in America, he has made his home in the Hawaiian Islands, where, for the last thirty years, he has conducted a dairy business with a market for his products located more than two hundred miles away. Mr. Carsley, on his return to the United States, was obliged to use the electric roads, and the impression that they made upon him awakened within him so great an interest in electricity that, although past seventy-four years of age, he promptly enrolled for an electrical engineering course. Mr. Carsley's record as a student is quite as remarkable as his progressive ideas. Enrolling on the twenty-eighth of last January, he has not only already completed his first seven books, but has taken on an average only three weeks for the completion of each—sometimes finishing a book in a week.

THE WESTERN ELECTRICAL SUPPLY CO., of St. Louis, is introducing the Jackson portable hammer, after having tested it thoroughly in every way. It states that this is the first and only electric hammer on the market, and marks a "new era" in reducing one half the cost of work now performed by the well-known pneumatic hammers. It can be used to advantage wherever chipping of any kind, riveting, calking or stone-dressing and carving is required. It is adapted for all classes of work now done by the pneumatic hammers, such as chipping iron or steel, in foundry work, bridge building, calking boilers, structural iron and building work, ship building, heavy stone dressing and light carving. The main points which the company claims for this hammer are its simplicity of construction, efficiency and durability. It is not necessary to install any new plant, as the current may be taken from any electric plant of from 110 to 500 volts. It can be operated by a motor of from ⅛ to ¼ hp, consuming no more current than an ordinary office fan. The cost is about twenty per cent. of a pneumatic hammer, and the cost of operation is about five per cent. One great advantage is that it can be run in the coldest weather, which is an impossibility with pneumatics. Where no current is obtainable, a small 1-hp electric generator is capable of running three hammers. Such a generator is quickly and cheaply installed, and may be operated by a small gasoline engine, turbine water wheel, or from shafting in machine shop or foundry. The company issues a bulletin fully describing this hammer, which is mailed on application.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUGUST 19, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

707,675. COMBINED OVERHEAD AND UNDERGROUND ELECTRIC RAILWAY; D. S. Bergin, Chicago, Ill. App. filed Feb. 10, 1902. Employs a separate underground conductor for the return current.

707,088. MAGNETIC SEPARATOR; A. Dings, Milwaukee, Wis. App. filed April 8, 1901. A rotary separator with a provision for rendering the operation continuous.

707,099. INCANDESCENT ELECTRIC LAMP; E. S. Gardner, Boston, Mass. App. filed July 22, 1901. A reflector is located within the lamp bulb.

707,150. SYSTEM OF ELECTRICAL DISTRIBUTION; W. S. Moody, Schenectady, N. Y. App. filed June 6, 1902. (See Current News and Notes.)

707,180. SELECTOR FOR RAILWAY SIGNALING APPARATUS; J. D. Taylor, Buffalo, N. Y. App. filed Nov. 10, 1900. Improvements on prior patents to same inventor.

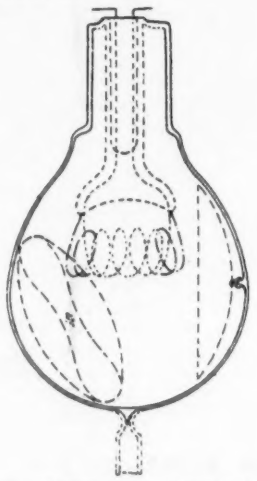
707,181. RAILWAY SWITCHING AND SIGNAL INTERLOCKING APPARATUS; J. D. Taylor, Buffalo, N. Y. App. filed Nov. 10, 1900. Improvements on prior patents to same inventor.

707,182. RAILWAY SIGNALING APPARATUS; J. D. Taylor, Buffalo, N. Y. App. filed Nov. 10, 1900. Improvements on prior patents to same inventor.

707,194. ELECTRIC RHEOSTAT OR HEATER; H. P. Ball, Brooklyn, N. Y. App. filed Nov. 2, 1896. The resistance wire lies in grooves between two corrugated plates riveted together, the wire being insulated from the plates.

707,222. AUTOMATIC LINE CATCH FOR TROLLEY WIRES; G. R. Floyd, Cincinnati, Ohio. App. filed Dec. 31, 1901. A safety device consisting of a supplemental wire or rod to the trolley wire at opposite sides of and beyond a point of probable breakage, by suitable holding ears, said wire having a limited longitudinal movement in said ears.

707,226. ELECTRIC BLOCK SYSTEM FOR RAILWAY TRAINS; J. T. Hambay, New York, N. Y. App. filed March 15, 1902. The semaphore is placed in the locomotive cab and is under the control of the tower-man or operator who has charge of the block.



707,099.—Incandescent Electric Lamp.

707,244. RESISTANCE FOR RHEOSTATS, ELECTRIC HEATERS, ETC.; H. W. Leonard, Bronxville, N. Y. App. filed Aug. 26, 1901. A metallic electrical conductor in the form of a ribbon arranged edgewise under tension around an electrical insulating surface capable of withstanding heat.

707,266. WAVE-DETECTING DEVICE; H. Shoemaker and G. W. Pickard, Philadelphia, Pa. App. filed June 2, 1902. A wave-responsive device comprising carbon terminals bridged by steel needles.

707,300. CONTROLLER FOR ELECTRIC MOTORS; W. H. Chapman, Portland, Me. App. filed March 12, 1902. The controller is adapted, without the use of switches, to start and stop the motor and reverse it my means of rheostats constructed to admit current gradually by fine gradations and in one direction or the other through the armature of the motor.

707,303. INSULATING JOINT FOR PIPES; F. E. Cleland and E. B. Murray, Des Moines, Iowa. App. filed March 10, 1902. Structural details.

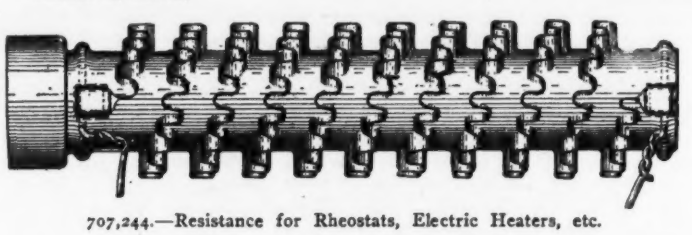
707,305. ELECTRIC SIGNAL FOR ELEVATORS; L. K. Curlett, Chicago, Ill. App. filed Nov. 7, 1901. A signal for elevators comprising an electrically operated signal carried by the car, and car-actuated contact devices to operate the signal when the floor of the car is flush with a floor of the building.

707,306. METHOD OF ELECTRODEPOSITING METAL ON LACE; J. A. Daly, Washington, D. C. App. filed Oct. 15, 1901. (See page 335.)

707,312. AUTOMATIC CIRCUIT CLOSER FOR TELEGRAPH KEYS; J. E. Folsom, Mitchell, Ill. App. filed Aug. 29, 1901. Details.

707,334. SYSTEM OF DISTRIBUTION; J. F. Kelly, Pittsfield, Mass. App. filed May 20, 1902. (See Current News and Notes.)

707,338. TROLLEY; P. E. Lorce, Dayton, Ohio. App. filed March 31, 1902. Structural details including a device for diminishing friction of lateral contact on curves.



707,244.—Resistance for Rheostats, Electric Heaters, etc.

707,363. GALVANIC BATTERY; E. L. Slocum, Pawtucket, R. I. App. filed July 1, 1901. Comprises a carbon or negative element made in four divisions, each division having in cross-section the form of a letter W forming ribs on both the outside and inside of the carbon and zinc elements held in the spaces between the divisions, and a containing jar.

707,372. ELECTROCHEMICAL GENERATOR; H. S. Amwake, Camden, N. J. App. filed June 13, 1902. The electrodes are surrounded by, but not in contact with, a case of carbon or other poor conductor, open at its lower end.

707,383. ELECTRIC ARC LAMP; C. L. Bundy, Philadelphia, Pa. App. filed Feb. 12, 1902. Relates to means for varying the attractive force of the magnets, and regulating the resistance of the coils interposed in the lamp circuit; also other details.

707,389. SYNCHRONOUS ALTERNATING-CURRENT MOTOR; A. Churchward, Fort Wayne, Ind. App. filed Oct. 1, 1898. (See Current News and Notes.)

707,390. SYNCHRONOUS ALTERNATING-CURRENT MOTOR; A. Churchward, Fort Wayne, Ind. App. filed Jan. 11, 1899. (See Current News and Notes.)

707,429. INSULATOR FOR ELECTRIC WIRES; T. F. King, Nashville, Tenn. App. filed Sept. 21, 1901. Structural details.

707,438. MEDICAL ELECTRODE; G. G. Marshall, Wallingford, Vt. App. filed May 2, 1902. A specially designed electrode for use by physicians in treating diseases of the stomach.

707,441. TELEPHONE RECEIVER; Lemuel Mellet, Somerville, Mass. App. filed July 5, 1901. (This patent will be described in next issue.)

707,505. ELECTRICAL SWITCH; L. L. Elden, Boston, Mass. App. filed April 15, 1901. An electric switch having a plurality of contact-makers in a successive series for transferring a circuit from one source of supply to another and a series of contacts co-operating therewith, the contact-makers being movable in an unvarying path only into successive contact with the series of contacts, the switch having a break position between every two make positions.

707,508. ELECTRIC ROLLER FOR MASSAGE AND THERAPEUTICAL PURPOSES; J. W. Gibbs, New York, N. Y. App. filed April 17, 1899. Embodies a magneto-generator located within a revoluble metallic cylinder.

707,516. PLUG RECEPTACLE; C. J. Klein, New York, N. Y. App. filed April 5, 1902. The face plate of a plug receptacle is provided with swinging doors which open inwardly on the insertion of a plug and close automatically upon its withdrawal and cover the opening.